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With METALLURGICAL SUPPLEMENT.

The Engineer.

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The Engineer

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The Director-General, India Store Department, Branch No. 15, Belvedere road, Lambeth, S.E. 1, invites TENDERS for :—
1. DUPLEX and HEAVY SIMPLEX DIAMOND SAWS, FRAME SAWS, and PLANING MACHINES for STONE DRESSING.
2. BRIDGE WORK.
Tenders due on the 12th February, 1926, for No. 1, and on the 16th February, 1926, for No. 2.
Tender forms obtainable from above. 1475

Civil Engineers (3) Required by the GOVERNMENT of SIERRA LEONE for the PUBLIC WORKS DEPARTMENT, for two tours of from 12 to 18 months' service, with possible extension. Salary £600, rising to £720 a year by annual increments of £30. Outfit allowance of £60 on first appointment. Free passages and quarters and liberal leave on full salary. Candidates, aged 30 to 35, must have served articles with a corporate member of the Institution of Civil Engineers, and have passed the examination qualifying for A.M.I.C.E. or hold equivalent professional qualifications. Must be good Draughtsmen, capable of Designing and Carrying Out Buildings, Bridges and other Engineering Structures and of Taking Out Quantities and Preparing Detailed Plans and Estimates. Must be competent to Execute Surveys and to Lay Out and Construct Roads, and have had experience as Civil Engineers on the Construction of Roads, Buildings and other Public Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,274. 1488

Quantity Surveyor Required for the PUBLIC WORKS DEPARTMENT of SIERRA LEONE, for two tours of 12 to 18 months' service, with possible extension. Salary £540, rising to £720 a year by annual increments of £30. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 28 to 35, must be fully qualified Quantity Surveyors experienced in the practice of "Taking Off," "Billing" and "Estimating" and "Measuring Up" for all classes of Building Work. Should have been engaged in a first-class Quantity Surveyor's Office, and preference will be given to candidate holding the Fellowship of the Surveyors' Institution in the Quantities Division.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/14,277. 1489

Required for Service under the GOVERNMENT of INDIA.
(a) FOREMAN for the Rifle Factory, Ishapore (Appointment 60).
Must have served definite apprenticeship with good firm of general engineers, followed by experience in other general engineering firms. A man engaged in production of small marine engines whose practical experience covers pattern shop, foundry, smithy and machine and erecting shops might be suitable. Must be educationally qualified to control shop training and able to lecture to student and trade apprentices. Age between 30 and 36 years. Salary Rs. 575-20-655 per mensem, with prospects of further increases.
(b) ASSISTANT FOREMAN, Examiner of Unfilled Ammunition and Material for No. 1 Charge, Ishapore (Appointment 61).
QUALIFICATIONS.—Knowledge of drawings and specifications, experience of moulding, foundry work, steel making and heat treatment of steels. Ability to use gauges, micrometer, sclerometer, &c. Knowledge of testing materials. Experience in inspection and proof of munitions. Age preferably not more than 35 years. Salary Rs. 450-15-510 per mensem, with prospects of further increases.
(c) ASSISTANT FOREMAN, Examiner of Unfilled Ammunition for No. 1 Charge, Ishapore (Appointment 71).
QUALIFICATIONS.—Must have experience in examination and gauging of shell up to 6in. size, bombs, fuses, primers, tubes, &c., and be acquainted with their use and functioning in the service. Conversant with proof routine and drawings of above types. Age preferably not more than 35 years. Salary Rs. 450-15-510 per mensem, with prospects of further increases.
TERMS (in each case).—Agreement for 5 years in the first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.
Further particulars and forms of application should be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 12th February, 1926. 1455

Surveyor Required by the GOVERNMENT of the GOLD COAST for the Takoradi Township Layout for a tour of 12 to 18 months' service. Salary £480 a year for the first year of service, then £510, rising to £720 by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, 25 to 35 years of age, must be qualified surveyors with a thorough knowledge of the use and adjustments of theodolite and accurate traversing. Should have had experience of demarcation and lay-out on ground (from plan supplied) of townships, &c.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14,023. 1473

BOILERS, HEATING APPARATUS, &c. TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 12th February, 1926, for SUPPLYING and FIXING BOILERS, PUMPS, PIPES, FITTINGS, HEATING APPARATUS, &c., at the Ministry of Pensions Hospital, Gledhow, Leeds.
Drawings, specification, a copy of the conditions and form of contract, schedule of prices and forms for Tender may be obtained from the CONTRACT BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea, (Cheques payable to the "Commissioners of H.M. Works, &c.). The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 1451

SHEET AND PLATE METAL WORK.

A Visiting Teacher in this subject is REQUIRED at the Verdin Technical School, Northwich, Cheshire, for Thursday afternoons, 2 to 5 p.m.
Applications to the PRINCIPAL, 1392

PUBLIC NOTICES

Crystal Palace School of Practical Engineering.
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MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
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The University of Birmingham.
FACULTY OF SCIENCE.
PROFESSORSHIP OF METALLURGY.
The Council of the University invites APPLICATIONS for the CHAIR of METALLURGY.
The stipend will be £1000 a year.
The Professor will be allowed to take higher consultative work, to keep in touch with metallurgical practice, provided that it does not interfere with his University duties.
Twenty-four copies of applications, together with copies of not less than three testimonials, references, or other credentials, if desired, should be received by the Secretary not later than March 1st, 1926.
The successful candidate will be required to take up his duties on October 1st, 1926.
Further particulars may be obtained from
C. G. BURTON,
1401. Secretary.

Imperial College of Science AND TECHNOLOGY.
CITY AND GUILDS (ENGINEERING) COLLEGE.
Mr. A. F. Wickenden having been appointed to the Chair of Architecture under the Egyptian Ministry of Education, the DELEGACY are prepared to consider APPLICATIONS for the POST of LECTURER in the Department of Civil Engineering and Surveying. Commencing salary £360 per annum, with the usual joint contributions to the Federated Superannuation System for Universities.
Applicants, who should be corporate members of the Institution of Civil Engineers, must be prepared to commence duty early in March, and should send their applications on or before 15th February to the SECRETARY to the DELEGACY, City and Guilds (Engineering) College, Exhibition-road, London, S.W. 7., from whom further particulars may be obtained. 1432

PUBLIC NOTICES

University College of South WALES AND MONMOUTHSHIRE.
COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.
AN ENGINEERING SCHOLARSHIP provided by the South Wales Institute of Engineers, of the value of £70 per annum, tenable for three years by a student who intends to enter some branch of the engineering profession, will be OFFERED for COMPETITION at the College Entrance Scholarship Examination, which begins on April 19, 1926.
Further particulars can be obtained from the undersigned, to whom the form of application must be returned on or before March 23, 1926.
D. J. A. BROWN,
Registrar.
University College, Cardiff,
January, 1926. 1458

Leith Dock Commission.
TENDERS FOR NEW REINFORCED CONCRETE GRAIN WAREHOUSE.
The Commissioners for the Harbour and Docks of Leith are prepared to receive from contractors who have had experience in similar work, TENDERS for the PROVISION and ERECTION of a NEW GRAIN WAREHOUSE and SILOS of REINFORCED CONCRETE, the building to occupy an area of about 170ft. by 110ft., on ground adjoining the East Quay of the Edinburgh Dock, Leith, the highest part of the building being about 150ft. above quay level.
On and after 25th January copies of the description of works, conditions of contract, specification, bill of quantities, general drawings, and forms of schedule of prices and Tender may be obtained from Alfred H. Roberts, Esq., M. Inst. C.E., Superintendent and Engineer, Dock Offices, Tower-place, Leith, Edinburgh, on payment of a deposit of Fifteen Pounds. An additional copy of the specification and schedules may be obtained upon a further deposit of Two Pounds. These deposits will be returned after the receipt of a bona fide Tender and on the return of all the documents.
The detailed drawings, showing steel work and other details, may, by appointment, be examined at the Engineer's office at the above address.
The Commissioners do not bind themselves to accept the lowest or any Tender.
Tenders, on the prescribed form, enclosed in sealed envelopes and endorsed on the outside "Tender for Grain Warehouse," must be delivered not later than 24th February, 1926, to the subscriber.
VICTOR A. NOEL PATON, W.S.,
Clerk to the Commission.
31, Melville-street, Edinburgh,
21st January, 1926. 1413

PUBLIC NOTICES

Aberdeen Corporation Electricity DEPARTMENT.
BOILER-HOUSE STEEL WORK.
The Town Council of Aberdeen are prepared to receive TENDERS for the SUPPLY, DELIVERY, and ERECTION of some 290 TONS of STRUCTURAL STEEL WORK of British manufacture, CORRUGATED IRON SHEETING, &c., forming an extension of the Boiler-house at their Ferryhill Power Station.
Specification, schedule of quantities, drawings and form of Tender may be obtained from the undersigned on payment of a deposit of £2 2s., which will be refunded after receipt of a bona fide Tender and the return of all documents and drawings.
Extra copies of the specification and schedule may be obtained on payment of 10s. per copy, which will not be returnable.
Sealed Tenders, endorsed "Boiler-house Extension," to be addressed to the City Electrical Engineer and delivered at his office, Millburn-street, Aberdeen, not later than 1 p.m. on 22nd February, 1926.
The Town Council do not bind themselves to accept the lowest or any Tender.
J. ALEX. BELL,
City Electrical Engineer.
26th January, 1926. 1479

Corporation of Dublin.
TUNNEL UNDER RIVER LIFFEY.
TENDERS are INVITED for the CONSTRUCTION of a TUNNEL under the River Liffey. The tunnel to be 7ft. 0in. internal diameter and about 818ft. in length, and the shafts to be 12ft. 0in. internal diameter.
Tenderers will be required to quote for (1) two shafts about 75ft. deep and a tunnel through the boulder clay, and (2) two shafts about 100ft. deep and a tunnel through the rock.
Description of work, conditions of contract and Tender form with accompanying drawings may be obtained on application to the City Treasurer, Exchange Buildings, Lord Edward-street, Dublin, on and after the 29th instant. Each application to be accompanied by a deposit of £1 1s., returnable on receipt of a bona fide Tender.
Tenders to be delivered under seal, addressed to "Commissioners for the County Borough of Dublin, City Hall, Dublin," and endorsed "Tunnel Under River Liffey," not later than Twelve Noon on the 2nd March.
The Commissioners do not bind themselves to accept the lowest or any Tender.
By Order,
JOHN J. MURPHY,
Town Clerk.
City Hall, Dublin,
26th January, 1926. 1484

County Borough of Southend-on-Sea.
SANDBERG STEEL RAILS, BRITISH MANUFACTURE.
TO CONTRACTORS.
The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of approximately 200 TONS of SANDBERG STEEL TRAMWAY RAILS, B.S. Section, Nos. 7 and 7c (straight and curved), and incidental WORKS in connection thereto.
General conditions, forms of Tender, and specification can be obtained on and after Monday, 1st February, on application to Mr. Robt. H. Dyer, Borough Engineer and Surveyor, on payment of a deposit of One Guinea, which will be refunded on receipt of a bona fide Tender and the return of all loaned documents.
Sealed Tenders, addressed to the undersigned and endorsed "Tender for Steel Rails," are to be delivered to this office on or before 9 a.m., Friday, 12th February, 1926.
The Corporation do not bind themselves to accept the lowest or any Tender.
H. J. WORWOOD,
Town Clerk.
Municipal Buildings,
Clarence-road, Southend-on-Sea,
25th January, 1926. 1448

Staffordshire Potteries Water BOARD.
HANCHURCH RESERVOIR EXTENSION.
The Board is prepared to receive TENDERS for the CONSTRUCTION of a Six Million Gallon RESERVOIR, built of Mass Concrete partly reinforced.
Plans may be seen and specification and bill of quantities obtained on or after the 1st February, 1926, at my office on payment of £5, which will be returned on receipt of bona fide Tender.
Tenders, accompanied by priced schedule, endorsed "Reservoir" and addressed to "Chairman, Staffordshire Potteries Water Board, Albion-street, Hanley, Stoke-on-Trent," must be received not later than Noon of Monday, 15th February, 1926.
The Board do not bind themselves to accept the lowest or any Tender.
R. C. FRAIN, M. Inst. C.E.,
Engineer and General Manager.
Albion-street, Hanley, Stoke-on-Trent,
January, 1926. 1463

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PUBLIC NOTICES

Scarborough Corporation.

NEW IRTON WATER SCHEME.—CONTRACT NO. 7.
SERVICE RESERVOIR.

The Corporation invite TENDERS for the CONSTRUCTION of a CONCRETE SERVICE RESERVOIR of 3,000,000 gallons capacity on Spring Hill, Scarborough.

The floor and walls will be of mass concrete and the roof reinforced with B.R.C. fabric. The work will also include heavy embanking and some pipe laying and accessories.

Copies of the conditions, specification, schedule of prices and form of Tender prepared by the Engineer, Dr. H. Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained on application to the undersigned on or after Monday, January 25th. The application must be accompanied by a sum of £5, which will be refunded on return of the documents within seven days or after the receipt of a bona fide Tender and the documents required.

Facilities for examining the drawings, for inspecting the site and general information can be obtained on application to Mr. Herbert Richardson, the Water and Streets Engineer to the Corporation, Town Hall, Scarborough.

Tenders are to be sent in on the form supplied, and with the annexed documents must be enclosed in a sealed cover, endorsed "New Irton Water Scheme: Tender for Contract No. 7," addressed to and reaching the undersigned not later than 10 a.m. on Monday, the 1st March, 1926.

The Corporation do not bind themselves to accept the lowest or any Tender.

SYDNEY JONES,
Town Clerk.

Town Hall, Scarborough,
January 22nd, 1926. 1433

Administrative County of LONDON.

ASSISTANT ENGINEER.

The London County Council invites APPLICATIONS for the APPOINTMENT of an ASSISTANT ENGINEER in the Department of the Chief Engineer. Candidates must be between 30 and 40 years of age (if not already in the Council's service), and Members or Associate Members of the Institution of Civil Engineers, with considerable experience both in the design and construction of civil engineering works. Preference will be given to candidates who have had control of drawing-offices and have knowledge and experience of the design of steel work in bridges and kindred structures.

The appointment will be on the established staff and the scale of salary attaching to the position ranges from £500, rising to £700 a year by annual increments of £25. The commencing salary within such scale will depend upon the experience of the successful candidate. This remuneration is based on pre-war conditions, and is at present subject to temporary additions on the Civil Service scale, fluctuating according to the cost of living. The temporary additions at the present time on a salary of £500 a year amount to £158 19s. 4d., and on a salary of £700 a year to £200 10s. 1d. The first year's service will be on probation, and the appointment will be terminable at the end of, or at any time during, that period.

Due weight will be given to the claims of those applicants who served or attempted to serve with H.M. Forces.

Forms of application can be obtained either personally or by sending a stamped and addressed foolscap envelope, marked "Assistant Engineer," to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1. The latest time for receiving applications is 11 a.m. on Monday, 22nd February, 1926. Canvassing disqualifies.

MONTAGU H. COX,
1485 Clerk of the London County Council.

Bombay, Baroda and Central INDIA RAILWAY.

JUNIOR REPAIR BOILERMAKER FOREMAN.

REQUIRED for service in India with the above Railway, a JUNIOR REPAIR BOILERMAKER FOREMAN, who must have served an apprenticeship in either a Locomotive Builder's or Railway Locomotive Shops, and in addition have had at least two years' experience as a Journeyman Boilermaker, and two years as a Boilermaker Chargeman in Railway Repair Shops. He must be conversant with all classes of repairs on locomotive, vertical and other type boilers, and it is most important that he should have had experience of being in charge of men. He should also hold a certificate of some technical training, and be able to work out all the formulæ in connection with the strength of materials, riveted joints, &c., as laid down in the Indian Boiler Act. He will be called upon to pass an examination in the Indian Boiler Act in due course in India. Candidates should be acquainted with modern and up-to-date workshop practice as regards boiler repairs. Age should not be over 30 years.

SALARY.—Rupees 500 per calendar month.

TERMS.—A three years' agreement in the first instance, with second-class free passage to India and home again on satisfactory termination of service.

The successful candidate will be required to pass a strict medical examination by the Company's Consulting Physician before actual appointment.

Applications (by letter only), giving candidates' age, whether married or single, and full details of general and technical education and training, in chronological order, with dates, making special reference to the class of work employed upon, &c., should be addressed to the undersigned not later than 8th February, 1926.

S. G. S. YOUNG,
Secretary.

Offices: 91, Petty France,
Westminster, S.W. 1.
26th January, 1926. 1478

Borough of Bexhill.

APPOINTMENT OF RESIDENT WATER ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of RESIDENT WATER ENGINEER at a commencing salary of £350 per annum.

Applicants must hold suitable engineering qualifications and have had considerable experience in water undertakings, preferably under municipal control.

The appointment will be subject to three months' notice on either side and the person appointed will be required to reside in the borough and devote his whole time to the duties of the office.

Applications, stating age, previous experience and present position, with copies of not more than three recent testimonials, to be delivered to the undersigned not later than Noon on Wednesday, the 17th February, 1926, endorsed "Water Engineer."

Canvassing, either directly or indirectly, will disqualify.

S. J. TAYLOR,
Town Clerk.

Town Hall, Bexhill,
20th January, 1926. 1447

The Assam-Bengal Railway Co., LTD.

ASSISTANT CIVIL ENGINEER.

REQUIRED, for service on the above Railway, an ASSISTANT CIVIL ENGINEER, who must have had a good general and technical education at a recognised engineering college and obtained a degree or passed the A.M. Inst. C.E. examination, and thereafter have had not less than one year's practical experience with a railway company or on public works in Great Britain. Age about 26 years.

SALARY.—Rupees 525 per calendar month.

TERMS.—A three years' agreement in the first instance, and first-class free passage to India.

The selected candidate will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full particulars of candidates' general and technical education and showing in chronological order (with dates) where such has been obtained, together with details of practical experience, &c., must be addressed to the undersigned not later than 1st February, 1926.

By Order of the Board,
OSWALD I. MILNE,
Secretary.

21st January, 1927.
Bishopsgate House,
80, Bishopsgate, E.C. 2. 1442

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PUBLIC NOTICES

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Good opening for energetic man. Manchester district.
State experience, salary required, and age.
Address, 1384, The Engineer Office. 1384 A

WANTED for London, GENERAL ENGINEER, with knowledge of Builders' Plant. Good opening for young energetic man. State age, experience, and salary.—Address, P1494, The Engineer Office. P1494 A

WANTED, MANAGER for Tin Canister Works. Must be familiar with costing and latest methods of production. State age, experience, and salary required to Box B. 567, care Jackson's, 19, Cullum street, E.C. 3. 1437 A

WANTED, Young Experienced MACHINE TOOL SALESMAN, with knowledge of Presses, Punches and Shears preferred. Applications, which will be treated strictly confidential, should state age, schooling and subsequent experience, salary required, when at liberty, and be accompanied by copies of testimonials, preferably also by photograph, which will be returned. Gentleman with connection amongst Government Departments, steel works, structural engineers, railway shops, shipyards and exporters preferred.—Write to E. REINECKE, Messrs. Henry Pels, 46, Great Marlborough-street, London, W.1. P1462 A

ASSISTANT ENGINEER REQUIRED for Municipal Waterworks, Tientsin. Salary 350 taels per month. Candidates must have experience in Design and Administration of Waterworks and of Running and Maintenance of Electrically Driven Pumps.—Application, stating age, qualifications, physical fitness, by letter only, and accompanied by testimonials, to Messrs. J. and A. LESLIE and REID, 73a, George-street, Edinburgh, not later than 12th February. 1460 A

CHEMIST WANTED by Large Firm of Cycle Manufacturers, Birmingham. Must have had experience Plating Solutions and Brazing Metals. State age, qualifications, and salary required. Address, 1454, The Engineer Office. 1454 A

DIAMOND DRILLER, Experienced, REQUIRED for India. Preferably one with Oil Well experience. Salary £40-£50 monthly, depending on experience, with board and room.—Write, with full particulars, copies of references, &c., to Box 141, c/o Dawson's, 17, Craven-street, London, W.C. 2. 1477 A

ELECTRICAL ENGINEER, with Good General engineering experience, WANTED, to Take Charge of Hydro-electric Power Plant, &c., in the East. Salary £960 per annum. Good climate. Free quarters. Cost of living low. Passages paid. Must have highest references as to character and ability.—Address, giving full particulars, 1474, The Engineer Office. 1474 A

ENGINEER.—Bright Young Energetic ENGINEER WANTED by Company manufacturing Liquid Fuel Burners and Oil-firing Apparatus. Experience of Oil Firing desirable.—Write full particulars, stating age, salary required, experience, &c., to Box G. A., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 1449 A

ENGINEER REQUIRED AT ONCE for Erection of Crushing Plant and Reinforced Concrete Bunkers. Cement experience useful.—Address, stating age, experience, and salary required, 1472, The Engineer Office. 1472 A

HEAD, WRIGHTSON and CO., Ltd., Thornaby-on-Tees, REQUIRE the SERVICES of an experienced ENGINEER to Estimate Cost of Foundations and Erection of Bridges, Caissons, Dock Gates, &c., and afterwards Superintend Erection of same. Must have had experience in personally designing special plant required.—Apply, giving full particulars of past experience, age, and salary required. 1430 A

REQUIRED for Service in India, an ASSISTANT to a DOCKYARD MANAGER, with a sound training in the design and construction of Hull and Machinery of Shallow-draught Steamers. Preference will be given to an applicant with experience in Estimating and Supervising Repairs of Light River Craft. Age not exceeding 35 and sound physique. State if married or single. Three years' agreement. Salary Rs. 700 to Rs. 800 per month. Free quarters provided.—Write, "Z. K. B.," c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 1483 A

WANTED by West of England Firm of Engineers, good MECHANICAL DRAUGHTSMAN with general experience in Automatic and Semi-automatic Machines. State age, experience, and salary required.—Address, 1436, The Engineer Office. 1436 A

WANTED, DRAUGHTSMAN, Accustomed to Maintenance work in a large factory specialising on mass production.—Address, stating experience, 1466 The Engineer Office. 1466 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Wireless in Merchant Ships.

ATTENTION has again been drawn to the question of wireless equipment for merchant vessels by the loss of the British steamer Elsdon, of Newcastle, which was recently posted at Lloyd's as "missing." This ship sailed from Immingham on December 18th with a cargo of coals for Odense, but was never heard of again. She is believed to have foundered in the Skagerrack, a ship's boat and a lifebuoy bearing her name having been washed up on the neighbouring coast. The Elsdon was not furnished with wireless, since, being of 1522 tons gross, she was exempt from the provisions of the Merchant Shipping (Wireless Telegraphy) Act of 1919, which requires all steamers of 1600 tons gross and upwards, coming to British home ports, to carry wireless equipment and operators. In the course of last year five vessels of small tonnage were posted as missing, none having had wireless on board. It is suggested in some quarters that the tonnage limit prescribed by the Act is unduly high, and might advantageously be reduced; but the matter is clearly not one that lends itself to hasty judgment. In the meantime the continuance of the strike among marine wireless operators is causing some concern in shipping circles. It was reported last week that 1500 operators were absent from duty, with the result that about 700 vessels were at sea with the wireless apparatus out of commission. The trouble has arisen out of a reduction in wages. It is fortunately by no means general, as many shipping companies are adhering to the original rates of pay and have therefore not been affected by the strike. The Ministry of Labour is intervening and hopes are expressed of an early settlement of the dispute.

The Sennar Dam.

THE Sennar Dam across the Blue Nile was formally opened on Thursday, January 21st, by Lord Lloyd, the British Commissioner for Egypt and the Sudan. The general features of the dam were described in our issue of September 26th, 1924, together with an account of the work upon it carried out up to the end of the working season, 1923–24. In our issue of July 3rd, 1925, our account of the work was brought up to date. Both these articles were fully illustrated by means of line drawings and progress photographs. The dam was completed some time ago, and on July 16th, 1925, water was admitted from it to the main Gezira irrigation canal. It has been constructed by the Sudan Government, with the assistance of the British Government, at a cost of £E13,000,000 and is designed to irrigate an area of about 300,000 acres. Nearly two miles in length and rising 85ft. above the bed of the river, it provides a reservoir with a capacity of 140,000 million gallons. From it the water is distributed over the Plain of Gezira by means of a main canal 70 miles long and a series of smaller canals having an aggregate length of some 680 miles. The completion of the dam and the works accompanying it will convert the all but useless soil of the Gezira Plain into a great cotton-growing region and will result in the Lancashire industry being partially freed from its dependence on American cotton. In the conception of the scheme Lord Kitchener played an important part, as did Sir Murdoch Macdonald, in connection with the design of the works. The consulting engineers were Messrs. Coode, Fitzmaurice, Wilson and Mitchell, and the contractors S. Pearson and Son, Ltd.

The Ouse Drainage District.

IN April of last year the Minister of Agriculture and Fisheries appointed a Commission of four members—Sir H. C. Munro, K.C.B., Sir John Oakley, past president of the Surveyors' Institute, Mr. W. J. E. Binnie, M. Inst. C.E., and Mr. Leopold Harvey—to investigate the whole problem of the drainage connected with the river Ouse with a view to advising the Ministry on the nature, extent and cost of the essential works required to put the Ouse drainage system in a proper state. The Commissioners reported on December 21st last, and with commendable promptitude the report has just appeared and is obtainable at H.M. Stationery Offices, price 2s. net. It is a lengthy document, running, with its appendices, to over fifty pages, and it has evidently been prepared with great care and after extended inquiry. For the moment we do no more than refer to some of the more important conclusions arrived at. First among them is that extensive works are necessary for the improvement of the tidal river and for the better utilisation of the wash lands. The estimated cost of these works is £2,500,000. Then, too, additional works are required to put the channels and banks in the South Level Area in good condition, and it is estimated that they will cost £216,000. Towards this expenditure it is considered that there should be a Government grant of at least £1,250,000, and that a contribution should be made by County Councils in respect of land within the Drainage District towards the expenses of the Drainage Board. It is also suggested that the upper portions of the Ouse and its tributaries should be taken out of the Drainage District and that the boundary of the District should be revised on the basis of the 20ft. contour line. It is further proposed that a subsidiary Board should be set up in the South Level to deal with the Old West and Ten Mile Rivers and their tributaries.

Labour Co-partnership.

AT a meeting of the Labour Co-partnership Association at Newcastle-on-Tyne last week Mr. J. S. Askwith, formerly senior accountant in the Department of Mines, advocated the more general introduction of co-partnership in the coal mining industry. As a practical experiment he suggested that for a period of five years each colliery undertaking should reward meritorious service on the part of its miners by granting to them free of charge a certain number of shares in the company. The money required for such purpose could, he said, be obtained either by the capitalisation of reserves or by the creation of an asset of goodwill, which would certainly come into existence to replace the existing barrier between the owners and the men. During the five years the miners should enjoy all dividend rights and all the capital and voting rights of ordinary shareholders. Mr. George Bell, of the General Federation of Trade Unions, suggested that some such scheme of co-partnership might be found suitable in the engineering industry.

The British Aircraft Industry.

THE decision of the Government to delay the provision of fifty-two squadrons of the Royal Air Force for home defence purposes is apparently likely to have a regrettable effect on the British aircraft industry. The industry is mainly, although not wholly, supported by the orders placed for military machines by the Air Ministry, so that the announced intention of postponing the completion of the home defence programme cannot fail to have a serious influence on the activities of our aeroplane manufacturers and aero-engine builders. It is reported that the effect of the decision has already become noticeable and that within the past two or three weeks several firms have been compelled to dismiss large numbers of their workpeople. One well-known firm is stated to have dispensed with the services of as many as 400 of its employees and to be preparing to discharge the remainder in a short time, retaining only a skeleton staff to carry on experimental work. The situation is no doubt a grave one, but, as has been pointed out before, progress in aeronautics depends upon a surprisingly small number of individuals. So long as the services of our expert designers and research workers are retained the situation will not become desperate from the national point of view, however unfortunate it may be from that of the individual manufacturers.

H.M.S. Amazon.

THE new torpedo-boat destroyer Amazon, which, as we recorded last week, was to have been launched from Messrs. Thornycroft's Southampton yard on the 16th, but which stuck on the ways as a result of the prevailing severe frost, was successfully sent afloat on Wednesday last, Jan. 27th. The propelling machinery of this destroyer will, we learn, consist of Brown-Curtis turbines, using superheated steam and driving the propellers through single-reduction gearing of the Parsons design. The boilers will be of the latest water-tube type. In number, the boilers will be fewer than in the earlier destroyer of the same name built by Messrs. Thornycroft in 1908, but they will have a greater heating surface and a higher steam pressure. The length allotted to the boilers and machinery in the new vessel is, in fact, considerably less than in the old, with the result that, although the new vessel is first and foremost a fighting unit of a most formidable kind, the accommodation for her crew has been greatly increased and improved.

The James Watt Lecture.

THE annual James Watt lecture was delivered before the Greenock Philosophical Society on Friday, Jan. 22nd, by Professor Percy A. Hillhouse, of Glasgow University. Professor Hillhouse took as his subject "Modern Ship Designs," and traced the progress of naval architecture during the past quarter of a century. Twenty-five years ago, he said, there was practically only one type of marine prime mover in use, the reciprocating steam engine, and only one means of generating the steam required, coal-fired boilers. Simplicity and uniformity had now disappeared. Turbines with a direct, single, or double reduction drive, Diesel engines of the two or four-stroke cycle, single or double-acting type, and mechanical, electrical or hydraulic transmission between the engines and the propellers had vastly complicated the propulsion problem and in turn had exercised a profound influence on the purely naval architectural side of ship designing. Yet while complexity had been increased so, too, had efficiency. The Aorangi could carry 4000 tons of cargo and fuel oil sufficient for the 15,000 miles' round trip from Vancouver to Sydney and back again. Had she been built twenty-five years ago and equipped with quadruple-expansion engines and coal-fired, forced draught boilers she would have been able to carry only half her present cargo and fuel sufficient for only a single trip. Again, twenty-five years ago the machinery of a cruiser gave about 11¼ horse-power per ton of weight and destroyer engines about 41 horse-power. To-day these figures were respectively about 29 and 75 horse-power. On the structural design side the classification societies had advanced steadily towards simplicity and efficiency. Many of the essential requirements of 1900 had been entirely discarded and the whole problem of strength had been placed on a healthy scientific basis. Any form of construction would now be considered on its intrinsic merits and not merely by its conformity with standard rules and tables.

Gas Centenary at Walsall.

ON Monday, January 25th, many visitors representing gas undertakings in various parts of the country participated in Walsall's gas centenary celebrations. It was in 1824 that Walsall first obtained parliamentary powers for public lighting by means of gas, and when the first gasworks was erected in Lichfield-street. At a later period the gas supply of the borough passed into the hands of the Birmingham and South Staffordshire Gas, Light and Coke Company, whose rights were acquired by the Birmingham Corporation in 1875. In 1877, however, the gas supply rights within the borough were purchased from Birmingham. The proceedings on Monday last included a tour of the Pleck Gas Works, where a new carbonising plant, which has been installed at a cost of about £27,000, was officially put into operation. At a luncheon which subsequently took place in the Council house, Mr. J. Ferguson Bell, of Derby, congratulated Walsall on having an up-to-date works in which full advantage was taken of modern improvements. He understood that about 700 million cubic feet of gas were manufactured per annum, and in spite of the fact that the prices charged compared favourably with those of other towns, the surplus profits had amounted to over £194,000, of which over £138,000 had been contributed in relief of the rates. The Government proposed to introduce a new electricity bill, but he hoped representatives in Parliament of towns like Walsall would see that nothing was done to place the gas industry in peril. It would be found that the cost of power for industrial purposes represented only 1 per cent. to 5 per cent. of the total costs, so that it could scarcely be argued that even if electricity could be produced at an extraordinary low price, it would mean that trade and industry would revive.

A Hydraulic Exhibition at Basle.

AT a recent banquet given to American and British officials by the Basle Government, both Mr. Hoag, the British Consul at Basle, and Mr. Lewis, secretary of the British Chamber of Commerce, expressed the hope that before the International Exhibition for Inland Navigation and Utilisation of Hydraulic Power opened in September, the British Government would find a way to be officially represented, and that British industries would show their products in the vast exhibition halls which were being completed at a cost of more than £80,000. The Basle Government is financing the exhibition in celebration of the opening of the Basle Rhine Harbour, at which merchandise loaded in London will be discharged direct at the Basle wharfs for transhipment to Switzerland and Central Europe without unloading at Rotterdam. Fifteen Governments, including those of France, Germany, Holland, Italy and the United States, will display goods relating to inland navigation or hydraulic and electrical power. By the time the exhibition opens the three Basle harbours, which have already handled as much as 320,000 tons of merchandise and coal and wheat shipments per year, will be completed. Direct passenger tugboat and barge service from Rotterdam to Basle will be in full operation this summer.

An Aero-engine Endurance Test.

IN order to afford a public demonstration of the trustworthiness of the Bristol "Jupiter" air-cooled aero-engine, a Bristol "Bloodhound" biplane fitted with the latest standard type of that engine is now being flown backwards and forwards between Filton Aerodrome, Bristol and Croydon. The engine before the tests began on January 4th was officially sealed by the Aeronautical Inspection Directorate in such a way that no replacements can be made without breaking the seals. Three sets of sparking plugs are in use, which are changed as occasion requires, but up to the present no engine replacements have been made. The latest information available shows that the machine has completed up to the present 67 hours 11 min. flying, in which time it has traversed a total of 7467 miles. Its average petrol consumption works out at 22½ gallons per hour.

Linoleum Machinery.

No. II.*

CORK GRINDING.

THE preparation of the cork for mixing with the cement, the production of which we have already described, is one of the chief anxieties of the linoleum manufacturer. For corticene, the cork is reduced until it will pass a screen of about 40 meshes per lineal inch, but for linoleum it must be much finer, say, about 90 meshes per inch. In either case, however, a considerable proportion of fine dust is produced, and since it makes a highly explosive mixture with air, the risk from fire in a cork mill is very severe. The cork, as it is imported, contains all sorts of foreign matter, and often pieces of metal are embedded right inside the thickness of the cork, so that they cannot be removed until the material is broken up. These pieces of metal may cause a spark and set fire to the cork or even produce an explosion. If it is a case of plain ignition in, say, a conveyor, the fire appears to spread in all directions, producing a globular glowing mass, and if it be observed in time the ball of fire can be picked out of the mass and a disaster be averted. The risk of fire is also present after the cork has been ground, and for that reason it is put up in bags for storage, as a burning bag can be readily detected by its smoke and its contents can be turned out on to the floor to be extinguished.

The cork is imported in bales of slabs and cuttings of all shapes and sizes. Care is taken in opening the bales to remove the wire banding, and the cork is generally passed over some device to remove any loose iron as it goes to the cork mill.

The general arrangement of the cork mill varies very greatly in different factories, but Fig. 6 illustrates one of the most modern equipments fitted up by the Melville-Brodie Company of Kirkcaldy. In this plant great pains have been taken to confine all the dust, with the idea of reducing the fire hazard, and to make the atmosphere as comfortable as possible for the workers.

The first operation is to break up the cork into pieces about the size of a nut, and that is done by a pair of spiked rolls. The rolls rotate in opposite directions, and are arranged below the floor. The cork coming from the breaker is sucked up by a fan, as shown in Fig. 6—and is delivered to a pulveriser. This machine has a fast running spindle fitted with radial arms, which beat the cork against the casing and reduce it very considerably. Another fan is used to lift the cork and deliver it to a cyclone in the top of the grinding mill. At this stage the cork is a mixture of extremely fine dust and small particles, and the dust is so light that the air leaving the top of the cyclone carries a considerable proportion away. The air is consequently taken to a secondary cyclone, or dust catcher, and is finally filtered through cotton bags. Between the dust catchers and the filter there is a branch pipe which can be used to take the air back to the cork breaker, so that it circulates round the apparatus continuously. The pulverised cork is discharged from the bottom of the main cyclone through a positive feed gear, which comprises a star wheel rotating in a cylindrical casing. It falls into a conveyor below and is taken to the grinding mills.

The mill stones are on the first floor, but are not shown in Fig. 6. Fig. 7, however, illustrates a set of four mills made by Bertrams, of Edinburgh. They are very similar to those used in the flour milling trade, and have stones about 4ft. in diameter running at 130 revolutions per minute or so. There is some divergence of opinion as to the best kind of stone to use for grinding cork, and while some millers say that there is nothing better than Derby grit, others insist that only natural lava is of any use. The stones require about 30 horse-power a pair. The cork is delivered to the stone through a hopper with a sliding door at the bottom, and then down a little pivoted shoot. By adjusting the slope of this shoot the attendant can regulate the flow to suit the rate at which the stones are working. The output of the mills varies very widely in different factories, as the millers are intensely conservative, and it is very difficult to get them to adopt modern practices. A good modern mill will, however, produce nine bags of ½-cwt. of ground cork from each pair of stones in an hour.

The ground cork coming from the mills is elevated to the top floor, and is passed through one or more dressing machines, very similar to those used in the flour trade, to grade it according to size. Such a machine, by Sir James Farmer, Norton and Co., of Salford, Manchester, is illustrated by Fig. 8. It comprises a riddle of fine mesh wire, which is rotated at a comparatively slow speed, while a set of beaters within is driven much faster. The fine cork escaping through the riddle collects in the bottom of the casing and is taken away by a screw conveyor, while the tailings escape at the end, to be returned to the mill stones—see Fig. 6—and go again through the mill until they are reduced to the requisite fineness. The finished ground cork is put up in bags and is stored under cover until it is required.

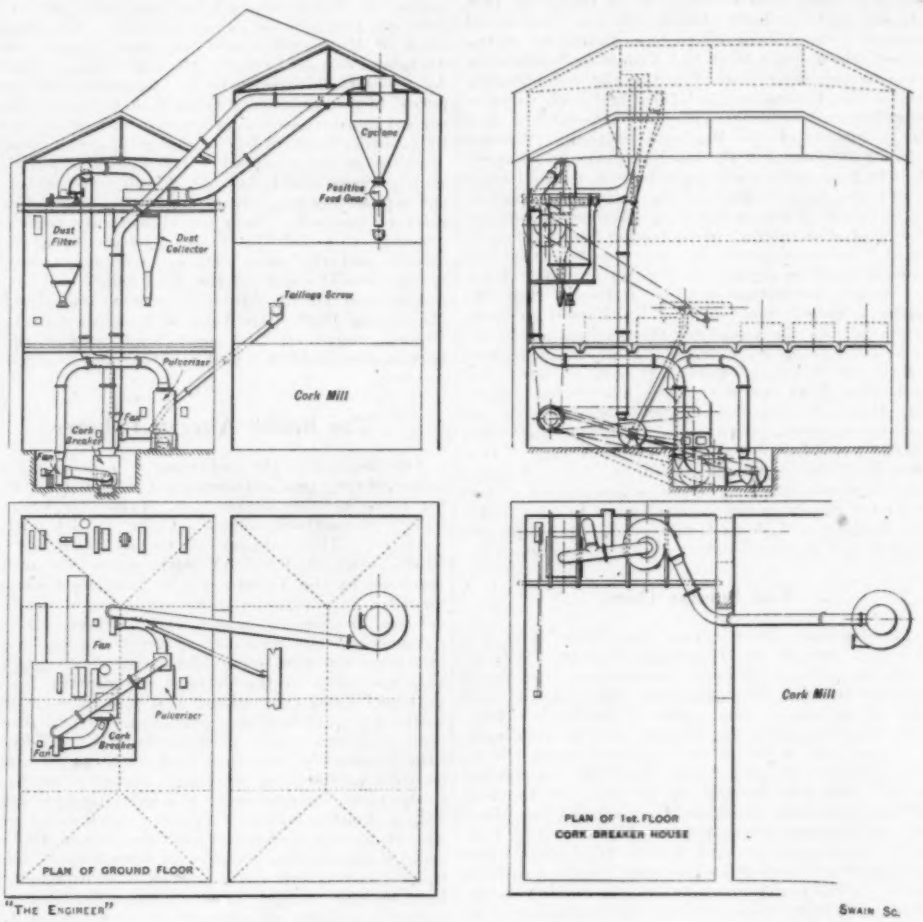


FIG. 6—GENERAL ARRANGEMENT OF CORK MILL

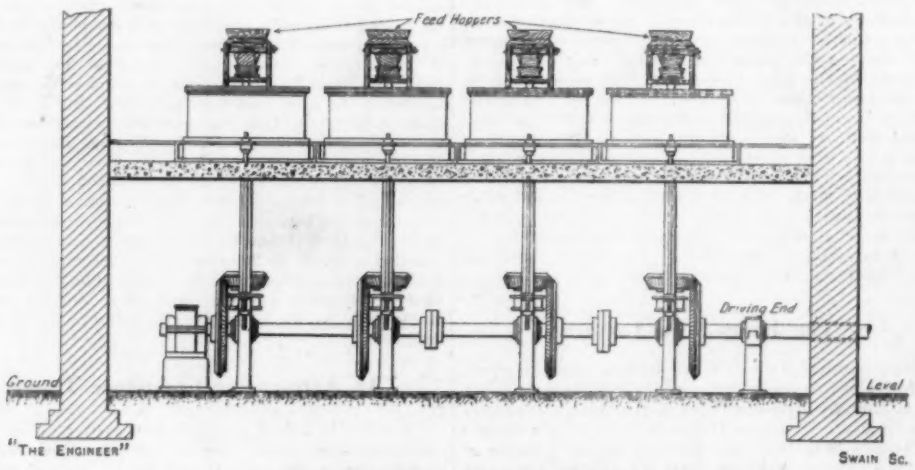


FIG. 7—CORK-GRINDING MILLS—BERTRAMS

MIXING.

The two essential ingredients of the linoleum having been prepared, it now becomes necessary to mix them thoroughly together with any desired pigment. To the average engineer the process of mixing employed in a linoleum factory seems very complicated, as the intermingling of two materials does not generally call for any very elaborate plant. The wearing qualities of linoleum depend, however, very largely on the effectiveness of the mixing and the process adopted is the outcome of long experience.

No two factories are alike in the arrangement of the mixing machines, but there is a general similarity in them in so far that various combinations of two distinct types of machines are employed. One type of mixer is equipped with rolls, between which the mixture is fed, while the other is more like a sausage machine and is colloquially known as a "German."

One arrangement of mixing plant designed by Sir J. Farmer, Norton and Co., is shown in the drawing—Fig. 9—and is more specially suitable for making corticene. Although it is simple by comparison with some of the schemes adopted in the large linoleum factories, it is typical to the extent that gravity is used, as far as is possible, in feeding the material from one machine to another.

The cement is very generally passed through an ordinary pug mill before it goes on to the mixers, especially in those works where a mixture of several grades of cement is used at one time; but in almost every case the first act of mixing the cement and cork together is carried out by a set of three rolls. It will be readily understood that it would be futile to attempt to start the mixing by feeding the cork and cement simultaneously between a pair of rolls, as they would go through quite independently. So the two ingredients are fed into the machine on opposite sides of the first roll. Fig. 10 is an illustration of a three roll mixer, by the Melville-Brodie Company, and in it there can be seen the hopper for

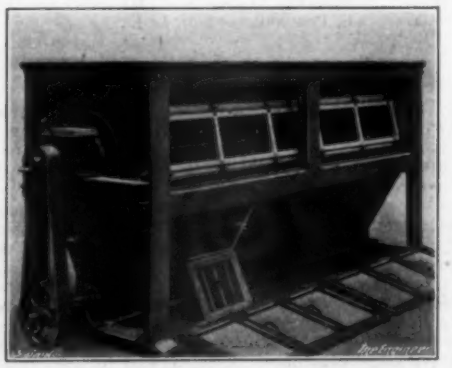


FIG. 8—CORK-DRESSING MACHINE—FARMER, NORTON

* No. I. appeared January 22nd.

supplying the ground cork. At the outlet from the hopper there is a fluted roll, which feeds the cork out in an even stream between the two lower rolls. The cement is put on the table, which can be seen in front of the machine, and is drawn in between the top roll and the lower one in front. It adheres to the lower roll and is pressed, together with the cork, between the lower pair. A scraper knife is made to bear against the lower front roll and peels off the mixture, which falls into the next machine below. The rolls are of chilled cast iron, and those shown in Fig. 10 are 16in. diameter by 48in. long.

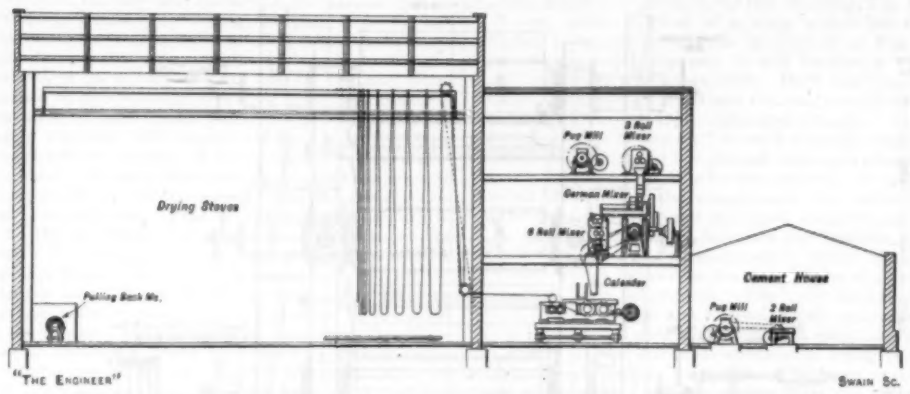


FIG. 9—GENERAL ARRANGEMENT OF LINOLEUM MIXING MACHINES AND DRYING STOVES

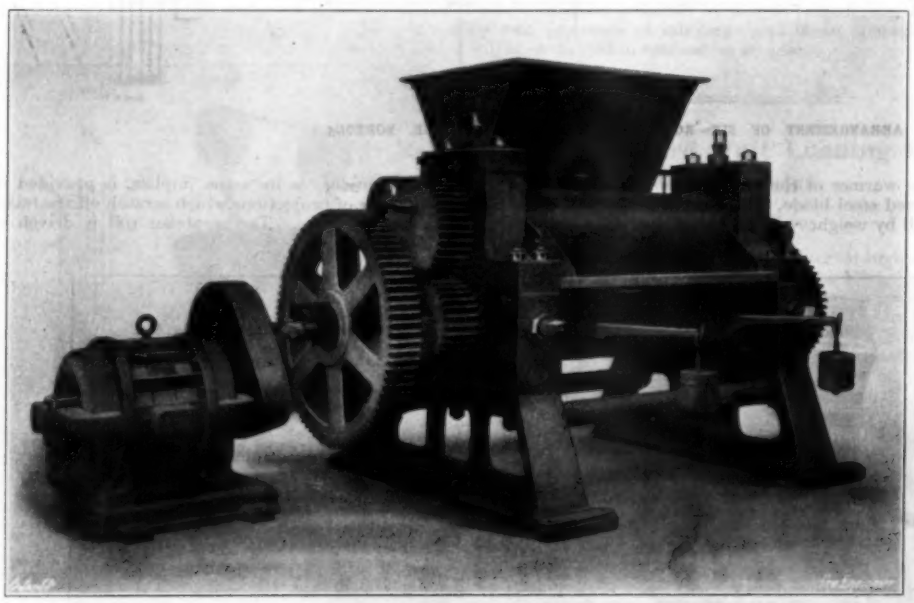


FIG. 10—THREE-ROLL LINOLEUM MIXER—MELVILLE-BRODIE

The second machine is generally a "German" mixer, which, as we have already observed, works somewhat after the fashion of a sausage machine. It is essentially a horizontal steam-jacketed cylinder, inside which there rotates a spindle provided with a number of knives that chew the mixture as it passes from end to end of the cylinder. These mixers are made in various sizes, with cylinders ranging in diameter from 10in. to 16in. An end section of such a machine, made by the Melville-Brodie Company, is given in Fig. 13. This "German" is, by the way, 10in. in diameter by 3ft. 1¼in. long.

As will be seen from Fig. 13, the cylinder is divided horizontally, and is held together by hinged bolts, so that it can be readily dismantled for cleaning or overhaul. It is provided with renewable liners, as the wear and tear on it is rather severe. At the level of the horizontal diameter there is a series of steel teeth projecting into the cylinder on either side. The spindle, it will be noticed, is octagonal, and on to it there are threaded the three-bladed cutting knives. The three blades are not spaced exactly equidistant round the circumference, so that, by taking advantage of this feature and the eight facets on the shaft, the cutters can be arranged to form a gradual helix. The front edges of the knives and of the teeth are bevelled and work quite close together, with the object of producing a shearing action on the mixture, as it is forced through the spaces between the teeth. The shaft runs at a speed of approximately 24 revolutions per minute. It requires a considerable amount of power to drive a "German" mixer, and that shown in Fig. 13 has a 35 brake horse-power motor. An independent drive is generally adopted, but in one factory we have visited three "Germans" were driven by a common motor of 95 horse-power. In that case the mixture was passed through the three mixers in succession. It is more usual, however, to alternate between "Germans" and roll mixers.

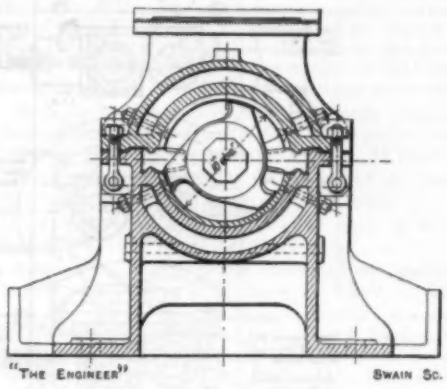


FIG. 13—"GERMAN" MIXER—MELVILLE-BRODIE

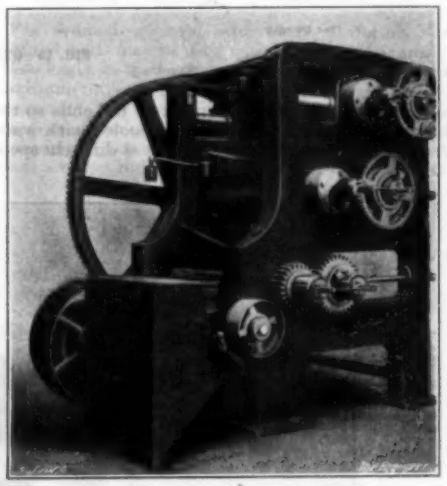


FIG. 14—SIX-ROLL MILL—MELVILLE-BRODIE

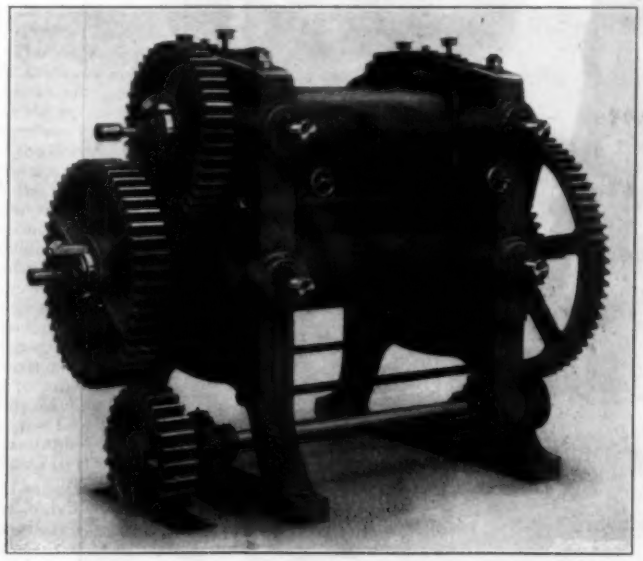


FIG. 11—FOUR-ROLL LINOLEUM MIXER—BERTRAMS

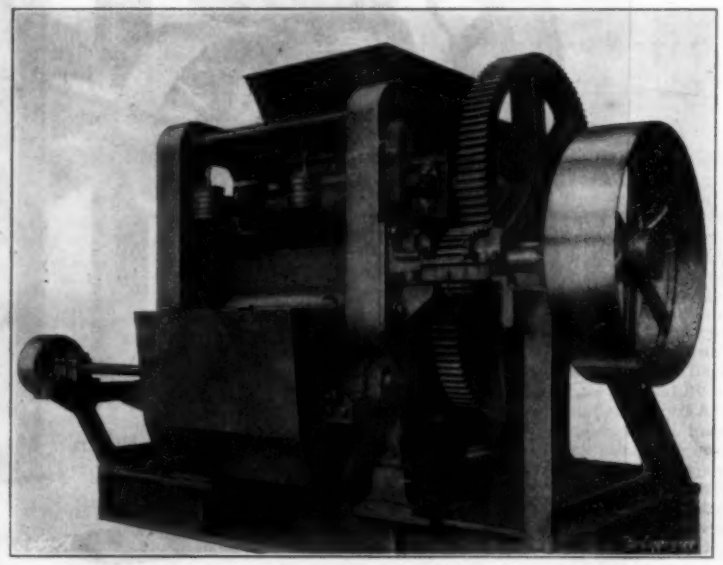


FIG. 12—FOUR-ROLL LINOLEUM MIXER—URQUHART, LINDSAY & ROBERTSON ORCHAR

The roll mixers have either four or six rolls, in pairs, according to the quality of the material being dealt

with, and three typical examples are illustrated in Figs. 11, 12 and 14. The rolls are of chilled cast iron, and have highly polished surfaces. They are hollow and connections are made at the ends so that they can be heated with steam or cooled with water. The two rolls of each pair are driven at different speeds in order to tear the mixture and roll it upon itself as it passes through. Practice varies somewhat as to the relative speed of the rolls, but it ranges about 3 or 4 to 1, and in one case which we timed the actual speeds were 35 and 11 revolutions per minute. After passing between the two rolls, the mixture adheres to the warmer of the pair, but is scraped off by a tempered steel blade, which is made to bear against the roll by weights on horizontal levers. The mixture scraped off by the blade drops into an intermediate hopper, passes through the next pair of rolls, and so on. In the case of the final mixer, which delivers the mixture ready for making up into linoleum, a "scratcher cylinder" is used instead of a blade to remove the material from the last roll. This cylinder, as its name implies, is provided with a number of projections which scratch off the mixture in fine particles. The scratcher roll is driven at a fairly high speed, which may range anywhere between 450 and 1000 revolutions per minute, and, as a consequence, the pegs have to be fixed securely, for fear

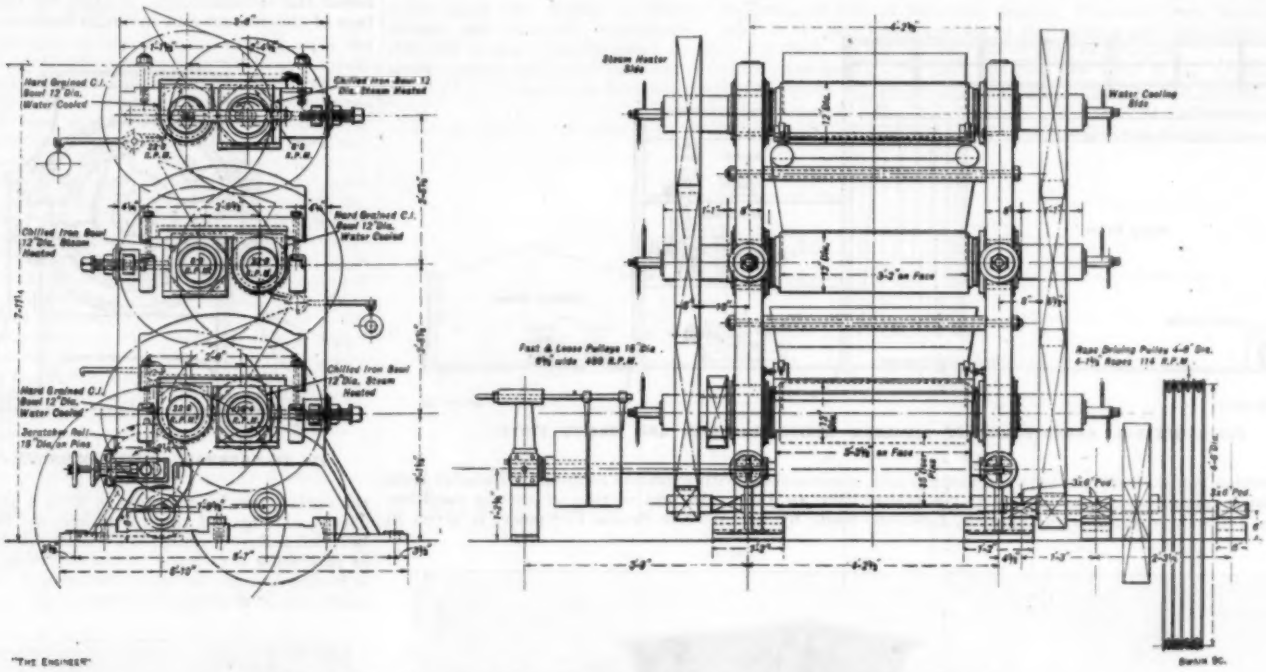

Hard Grained C.I. Roll 13" Dia. Water Cooled
Chilled Iron Roll 12" Dia. Steam Heated
Chilled Iron Roll 12" Dia. Steam Heated
Hard Grained C.I. Roll 12" Dia. Water Cooled
Hard Grained C.I. Roll 12" Dia. Water Cooled
Chilled Iron Roll 12" Dia. Steam Heated
Scratcher Roll 18" Dia. on Pins
Steam Heated Side
Water Cooling Side
Fast & Loose Pulleys 16" Dia. 9½" wide 480 R.P.M.
Roll Driving Pulley 4'-6" Dia. 6-1½" Ropes 114 R.P.M.
3'-0" Pod.
3'-0" Pod.
4'-6" Dia.
"THE ENGINEER"

FIG. 15—GENERAL ARRANGEMENT OF SIX-ROLL LINOLEUM MIXER—FARMER, NORTON

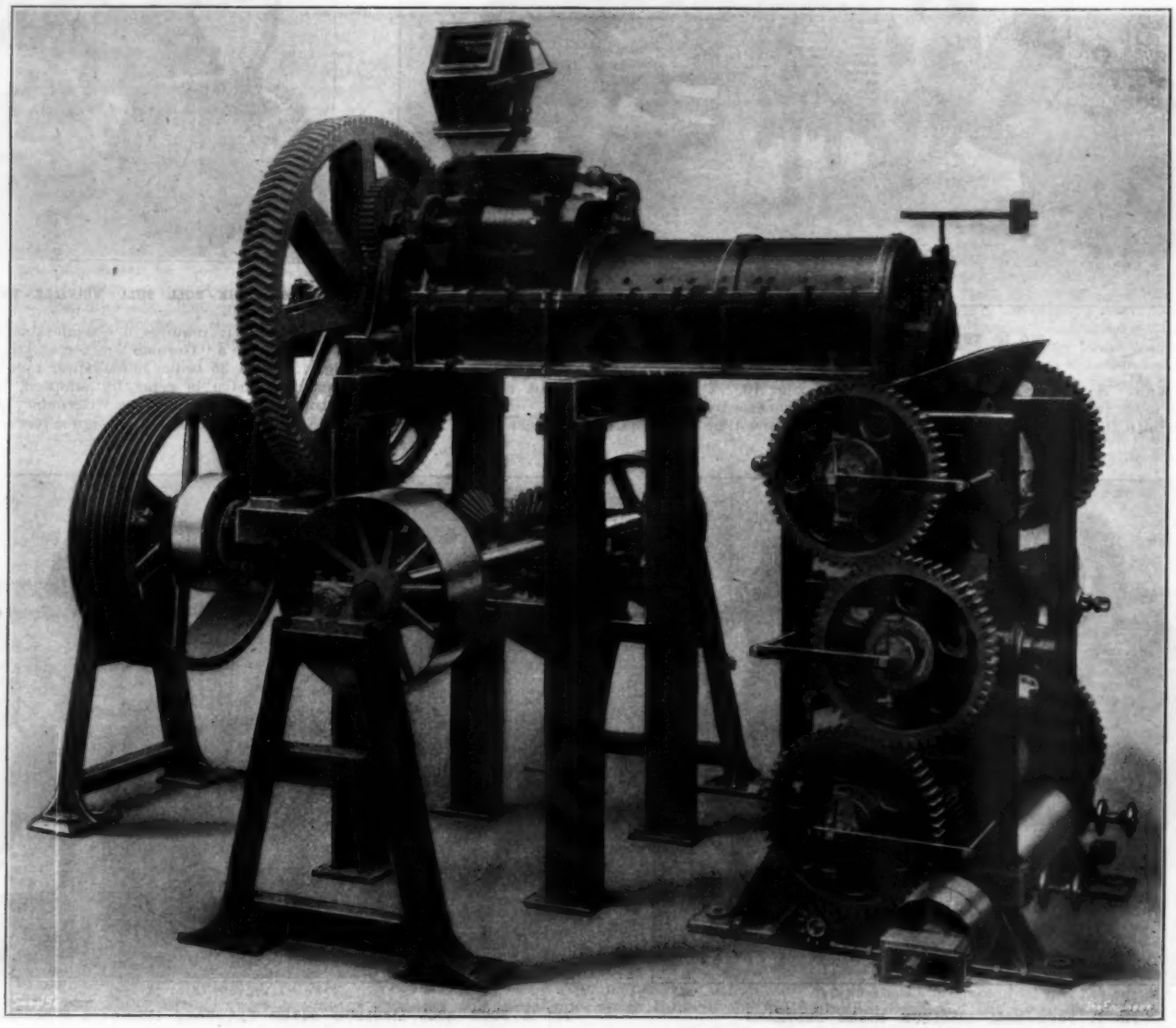


FIG. 16—COMBINATION OF "GERMAN" AND SIX-ROLL LINOLEUM MIXERS—FARMER, NORTON

they might fly out and damage the machinery. We have, however, seen scratcher rolls, made in an emergency, clothed with wire nails driven through pieces of leather. The arrangement adopted in the case of the mixer shown in Fig. 13, which is by Urquhart, Lindsay and Robertson Orchar, of Wallace Foundry, Dundee, for fixing the pegs is as follows. The scratcher roll is built up of a cast iron cylinder mounted on cast iron circular ends, which, in turn, are keyed on a turned steel arbor. On the outer surface of the cylinder there is fitted a number of extruded or hard-drawn brass staves which fit accurately together with bevelled edges so as to cover completely the surface of the cylinder. These staves are fixed to the cast iron cylinder by steel screws with countersunk heads, the screws being staggered round the circumference. Pins are driven into the staves from the underside, *i.e.*, the side which is next the face of the cast iron cylinder, and as they are slightly tapered, there is no risk of their being thrown off the into the mix. It should be mentioned that the pins are not inserted radially, but lie at an acute angle to the tangent, the points lying back from the direction of rotation. These pins are arranged in longitudinal rows across the face of the scratcher roll, and are staggered so that every part of the chilled roll surface is cleaned. The staves are interchangeable so far as the staggered screws will permit, and great care is taken to balance the roll at all stages of its manufacture. The arbor runs in ring-oiling bearings, which can be adjusted outwards or inwards to allow for wear on the ends of the pins. A steel casing is arranged round this roll and is provided with a hinged front to give ample access for replacing staves,

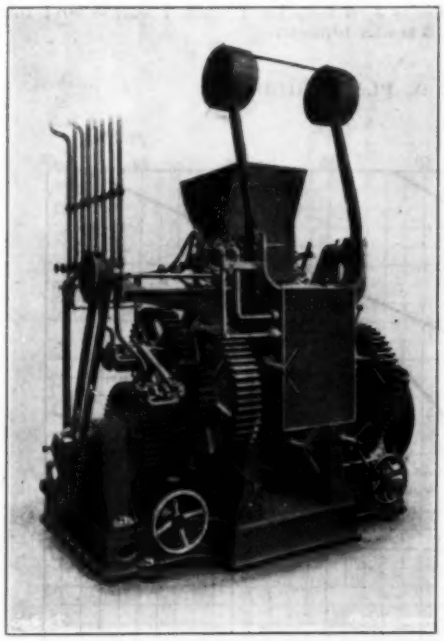


FIG. 17—LINOLEUM MIXER—BAKER, PERKINS

while the top of the casing is removable for inspection purposes.

The engraving—Fig. 11—is of a four-roll mixer by Bertrams, of Edinburgh, and gives a very good idea of the gearing used to drive the several rolls. On the extreme left of the illustration, it will be seen, there are two wheels in the same plane. The pinion of the driving motor meshes with both these wheels. The upper of these two wheels is keyed on to the end of the lower back roll, and behind it there is another gear wheel which drives the top front roll. The second of the two wheels gearing with the motor pinion, that on the countershaft below, drives the front bottom roll through the large spur wheel at the back. Another wheel, keyed on to the same shaft as the large spur wheel, engages with one, out of sight, for driving the top back roll. By following out this train of gearing it will be found that all the rolls turn downwards on the inside, and the ratios are so proportioned as to produce the tearing action already referred to. This machine has rolls 14in. in diameter by 36in. long on the face and requires about 40 horse-power. It is suitable for milling up scrap ends of linoleum for adding to the mixture for the sake of economy.

The mixing mill—shown in Fig. 14—which is by the Melville-Brodie Company, is, it will be seen, of the six-roll type, and is noteworthy on account of the substantial design of its framework. The scratcher cylinder is built up in very much the same manner as that described in connection with Fig. 12. *Apropos* scratcher cylinders, those made by the Staines Company are, perhaps, among the most substantial. They are built up of a cast iron centre and a surrounding sleeve. The sleeve is drilled with holes countersunk on the inside and correspondingly turned pegs are then driven in from within. The sleeve is bored, to smooth off the heads of the pegs, and is shrunk on to the centre. It is an expensive form of construction, but is obviously immune from failure, and is said to be justified by the damage which is caused if a piece of metal finds its way into the mixture. The general arrangement of a six-roll mixer by Sir J. Farmer, Norton and Co., is given in the line drawing, Fig. 15.

A very direct method of mixing, which has been adopted in some factories, is illustrated by Fig. 16. The arrangement comprises, it will be seen, a "German" mixer and a set of six rolls. Both machines are by Sir J. Farmer, Norton and Co., and are driven by rope gearing through the countershaft shown. At the inlet end of the "German," there is a small weighing machine for feeding in the ground cork, and alongside there is a pair of feed rolls for the cement. It will be noticed that, when the photograph was taken, the scratcher cylinder was not equipped with its pegs.

In some few linoleum factories the familiar type of mixer used in bakeries, and made by Baker, Perkins, of Peterborough, is used in the early stages of mixing, but needs little description. The only direction in which it differs from the normal dough mixer is in the provision of a weighted lid, which slides down in the casing as the materials subside on being mixed together, and thus keeps the batch in good contact with the stirrers. Messrs. Baker, Perkins are also now experimenting with a new type of mixer—illustrated by Fig. 17, in which the charge can be emptied out at the front without tilting; but the time is hardy ripe for its detailed description.

We have now followed the process through to the point at which the linoleum "mix" is ready for its application to the canvas backing, which is effected in three distinct fashions by simple calendering, and by two processes of inlaying—and these operations will be described in succeeding articles.

British Standard Unit Loading for Highway Bridges.

By J. M. LIDDELL, B.Sc.

THE new British Standard unit loading for highway bridges replaces previous standards of the Ministry of Transport and its adoption will be required in general for new bridges and reconstruction work aided by the Department. That a considerable amount of bridge strengthening is necessary owing to the increase during recent years in the volume and weight of road traffic is well known, and it is a complement of the many new road schemes now in hand or projected, that numerous new bridges are required.

The unit load system will be a great convenience to all designing engineers, and as it will be almost exclusively adopted in this country, a brief description of its main features is given. By the use of the charts reproduced herewith the labour required to determine the maximum stresses in bridges due to the new loading may be reduced by an average of at least 80 per cent. At the same time, the accuracy afforded by the methods described is more than sufficient for practical purposes. The error, as compared with that of the most exact methods, is commonly negligible, and seldom exceeds 1 per cent. The greatest facility of calculation is possible with plate girders and the more usual forms of framed girders, but by proceeding in the manner indicated the maximum stresses due to the loading in cantilevers, arches, and other special structures can also be readily and accurately estimated. Illustrative examples are worked out to show the use of the charts in several cases.

EXPLANATION OF CHARTS.

Description of Unit Loading.

The charts are based on "The Unit Loading for Highway Bridges," recently published by the British Engineering Standards Association (Crosby Lockwood and Son, June, 1925, 1s. net). As illustrated on chart B, the loading is a type loading selected from the heaviest ordinary traffic at present using road bridges in this country, or anticipated in the near future, but having a simplified wheel spacing. The unit load on the heaviest axles is 1·0 ton. Variations in intensity of loading, to suit different conditions, are secured by the adoption of different multiples of the unit system, the wheel spacing remaining the same. The stresses due to any multiple of the unit loading are obtained by increasing the calculated unit values in the same proportion. For first-class country roads a 15-unit loading is recommended. Impact is not included in the unit loading and is to be allowed for in accordance with the current British Standard Specification for Girder Bridges.

Maximum Stresses in Plate Girders.

Chart A has been prepared for plate girders up to 100ft. span, the curves being plotted by permission from the B.E.S.A. tables. The values of the maximum bending moment near the centre of the span, and the maximum shearing force at the abutments can be obtained at sight. In preliminary work these quantities are all that are required. It is sometimes necessary, however, to determine the values of the maximum bending moment and maximum shearing force at every point in the span. For this purpose the approximate constructions indicated below the chart may be used. The additional quantities involved are the values of the maximum bending moment at the ¼ points, and the maximum shearing force at the centre of the span, and these are given on the chart. It may be noted that the constructions give exact values near the centre of the span and at the abutments, in each case. Consequently, no material may be wasted at these points where the greatest stresses in the girder occur. The chart also gives the values of the maximum reaction on cross girders for spacings up to 40ft.

Example 1.—Required the maximum bending moment near the centre of a 60ft. plate girder, supporting 2 tracks of the standard loading, 15 units.

From Chart A, max. B.M. for 1 track of unit loading near centre of 60ft. span = 27·8 ft.-tons.

∴ For 2 tracks of 15-unit loading, max. B.M. = 27·8 × 2 × 15 = 834·0 ft.-tons.

Example 2.—Required the maximum end reaction for 80ft. span carrying 1½ tracks of 5-unit loading.

From chart A, max. end reaction (*i.e.*, shearing force at abutments) for 1 track of unit loading on 80ft. span = 2·565 tons, ∴ for 1½ tracks, 5-unit loading, end reaction = 2·565 × 1½ × 5 = 19·24 tons.

Example 3.—Required the maximum cross girder reaction, spacing = 12ft. for 1 track, 10-unit loading.

From chart A, max. cross girder reaction, 12ft. spacing, for 1 track of unit loading = 1·133 tons.

∴ For 1 track, 10-unit loading, max. reaction = 1·133 × 10 = 11·33 tons.

Maximum Stresses in Framed Girders.

For framed girders, equivalent uniformly distributed loads may be used with particular advantage. These loads, in traversing the span, produce the same maximum stresses as would be produced by the passage of the actual wheel concentrations. The selection of the uniform load for the maximum value of any stress is made by inspection of the form of the corresponding influence line, and the product of the

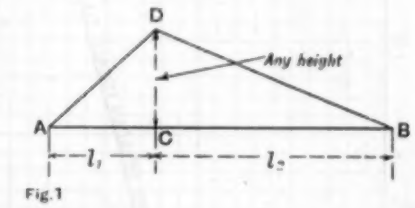


Fig.1

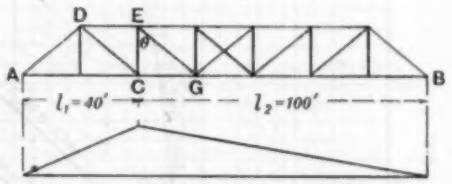


Fig.2 *Influence line for Stress in D.E.*

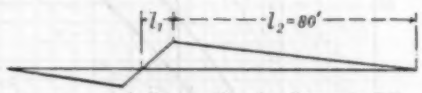


Fig.3 *Influence line for Stress in E.G.*

"THE ENGINEER" SWAIN Sc.

load per lineal foot and the area enclosed by the influence line gives the value of the stress.

A triangular influence line for any stress, as A D B in Fig. 1, is of the same form as one for bending moment at the point C in span A B. Consequently, the position of the concentrated loads for a maximum value is the same in both cases, and an equivalent uniformly distributed load derived from the latter, is correct for the former. From the curves on Chart B the value of this load per lineal foot, denoted by q, for any two segments l_1 and l_2—corresponding to A C and C B in Fig. 1—of spans from 40ft. to 500ft., may be read off at a glance, by following along the two straight lines representing the segments until they intersect. The influence lines for stress in the chord and web members of various types of girders are shown alongside the chart. Simple expressions are given, from which, when q has been found, the values of the maximum stresses can be readily obtained.

Example 4.—Required the maximum stress in the chord member D E of the truss illustrated in Fig. 2. Span = seven panels at 20ft. = 140ft., depth = 24ft., loading, two tracks per girder of standard loading 15 units.

q = uniform load for segments l_1 (= 40ft.) and l_2 (= 100ft.) = ·0530 tons-feet for one track one unit (from chart B). Substituting in equation (1),

chart B, maximum stress in D E for 1 track 1 unit $= \frac{1}{2} \times \cdot0530 \times \frac{40 \times 100}{24} = 4 \cdot 44$ tons.

∴ For 2 tracks of 15-unit loading, max. stress $= 4 \cdot 44 \times 2 \times 15 = 133 \cdot 2$ tons.

Note.—By calculation from concentrated loads, max. stress in D E = 133·0 tons. ∴ Error = 0·16 per cent.

Example 5.—Required the maximum stress in the member E G of the truss in Example 4, with the same load system.

In Fig. 3 $l_1 = \frac{l_2}{7-1} = 13 \cdot 3$ (see chart B).

q = uniform load for segments l_1 (= 13·3ft.) and l_2 (= 80ft.) = ·0566 tons-lin. feet for 1 track 1 unit.

Substituting in equation (2A), chart B, max. stress in E G for 1 track 1 unit

$$= \frac{1}{2} \frac{\cdot0566 \times 13 \cdot 3 \times 80 \times \sec. \theta}{20} = 1 \cdot 95$$

∴ For 2 tracks of 15-unit loading max. stress $= 1 \cdot 95 \times 2 \times 15 = 58 \cdot 5$ tons.

MAXIMUM PIER REACTIONS.

The uniform load method can be applied directly to the determination of maximum pier reactions, as indicated on chart B.

Example 6.—Required the maximum pier reaction on pier between spans of 80ft. and 120ft., due to the passage of 4 tracks of the standard loading, 15 units. From chart B, q, for segments l_1 (= 80ft.,) l_2 (= 120ft.), = ·0510 for 1 track of the unit loading.

Substituting in formula (4), chart B, max. reaction $= \frac{1}{2} \times \cdot051 \times (80 + 120)$ for 1 track 1 unit = 5·1 tons for 1 track 1 unit.

∴ Max. reaction for 4 tracks, 15 units = 5·1 × 4 × 15 = 306·0 tons.

APPLICATION TO OTHER STRUCTURES.

In the case of cantilevers and three-hinged arches, triangular influence lines are met with. Consequently, the maximum stresses can be found by the uniform load method. In other cases, where slight deviations from the triangular form of diagram occur, a sufficiently close approximation to the correct value of q may be obtained by replacing the influence line by two straight lines forming a triangle with about the same average ordinates. The uniform load being determined from the triangular diagram, the value of the stress is represented by the product of q and the area enclosed by the true influence line.

Example 7.—Required the max. B.M. at the pt. C in the cantilever span shown in Fig. 4, due to loading of 2 tracks 10 units standard highway.

q = uniform load for segments l_1 (= 30ft.) and l_2 (= 60ft.) = ·0559.

Max. B.M. at C = q × area of Δ C^1 B^1 D^1 = ·0559 × ½ × 30 × 90 = 75·5 ft.-tons for 1 track 1 unit.

For 2 tracks 10 units, max. B.M. at C = 75·5 × 2 × 10 = 1509·0 ft.-tons.

By calculation from axle loads, exact value = 1505 ft.-tons. ∴ Error = 0·3 per cent.

Example 8.—Required the max. stress in the member C D of the Warren girder in Fig. 5. Loading 3 tracks 10 units standard highway.

In this case the influence line is not exactly triangular. From dotted triangle, q = uniform load for segments l_1 (= 31ft.) and l_2 (= 69ft.) = ·0548 tons-lin. ft.

Max. stress in C D = q × area of true influence figure = 3·04 tons for 1 track 1 unit = 90·1 tons for 3 tracks 10 units.

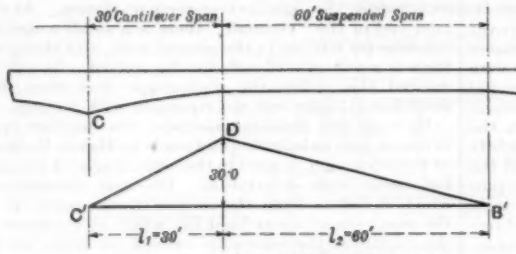


Fig.4 "THE ENGINEER" *Influence line for B.M. at C.*

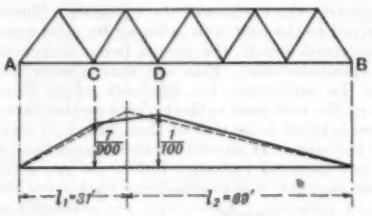
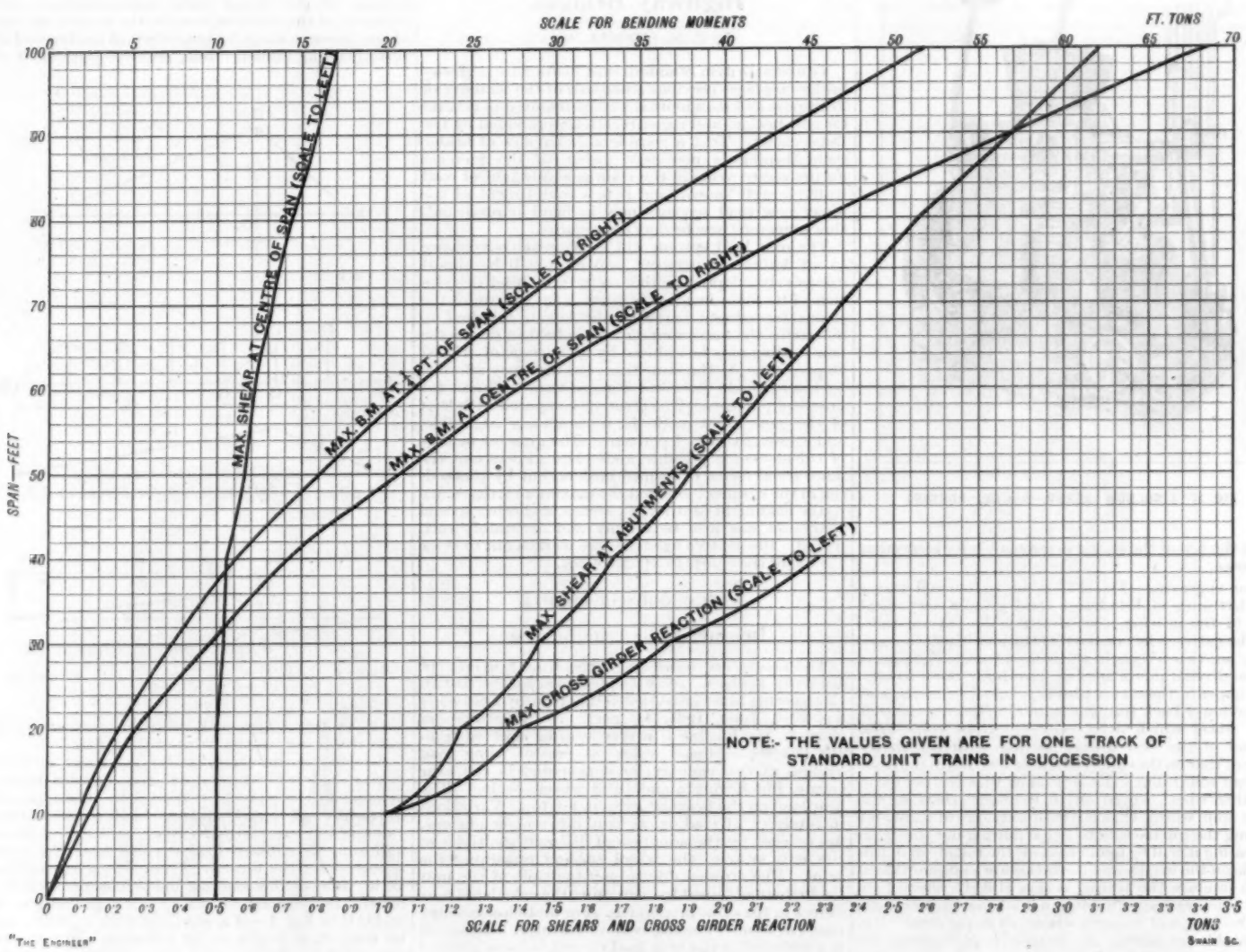


Fig.5 *Influence line for Stress in C.D.* SWAIN Sc.

BRITISH STANDARD UNIT LOADING FOR HIGHWAY BRIDGES—CHART A, PLATE GIRDERS


SCALE FOR BENDING MOMENTS
FT. TONS
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
100 90 80 70 60 50 40 30 20 10 0
SPAN—FEET
MAX. SHEAR AT CENTRE OF SPAN (SCALE TO LEFT)
MAX. B.M. AT ¼ PT. OF SPAN (SCALE TO RIGHT)
MAX. B.M. AT CENTRE OF SPAN (SCALE TO RIGHT)
MAX. SHEAR AT ABUTMENTS (SCALE TO LEFT)
MAX. CROSS GIRDER REACTION (SCALE TO LEFT)
NOTE:- THE VALUES GIVEN ARE FOR ONE TRACK OF STANDARD UNIT TRAINS IN SUCCESSION
0 0·1 0·2 0·3 0·4 0·5 0·6 0·7 0·8 0·9 1·0 1·1 1·2 1·3 1·4 1·5 1·6 1·7 1·8 1·9 2·0 2·1 2·2 2·3 2·4 2·5 2·6 2·7 2·8 2·9 3·0 3·1 3·2 3·3 3·4 3·5
SCALE FOR SHEARS AND CROSS GIRDER REACTION
TONS

"THE ENGINEER" SWAIN Sc.

Approximation to Maximum Bending Moment at every Point of Span.—On span A B erect D F and E G at the ¼ pts., making D F = E G = max. B.M. at ¼ pts. Draw parabola A F K G B (for this purpose C K = ½ D F). Erect C H = max. B.M. near centre of span, and draw through H a straight line parallel to A B.

The shaded diagram—Fig. 6—represents very nearly the distribution of max. B.M. due to the loading along the span.

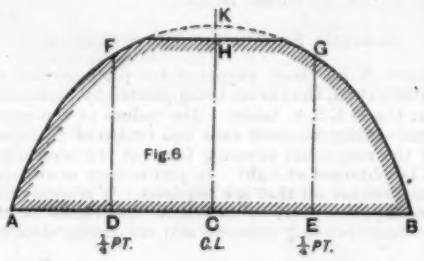


Fig.6

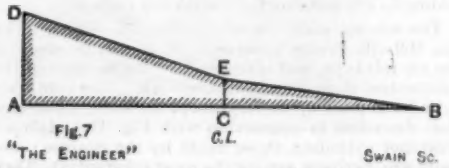
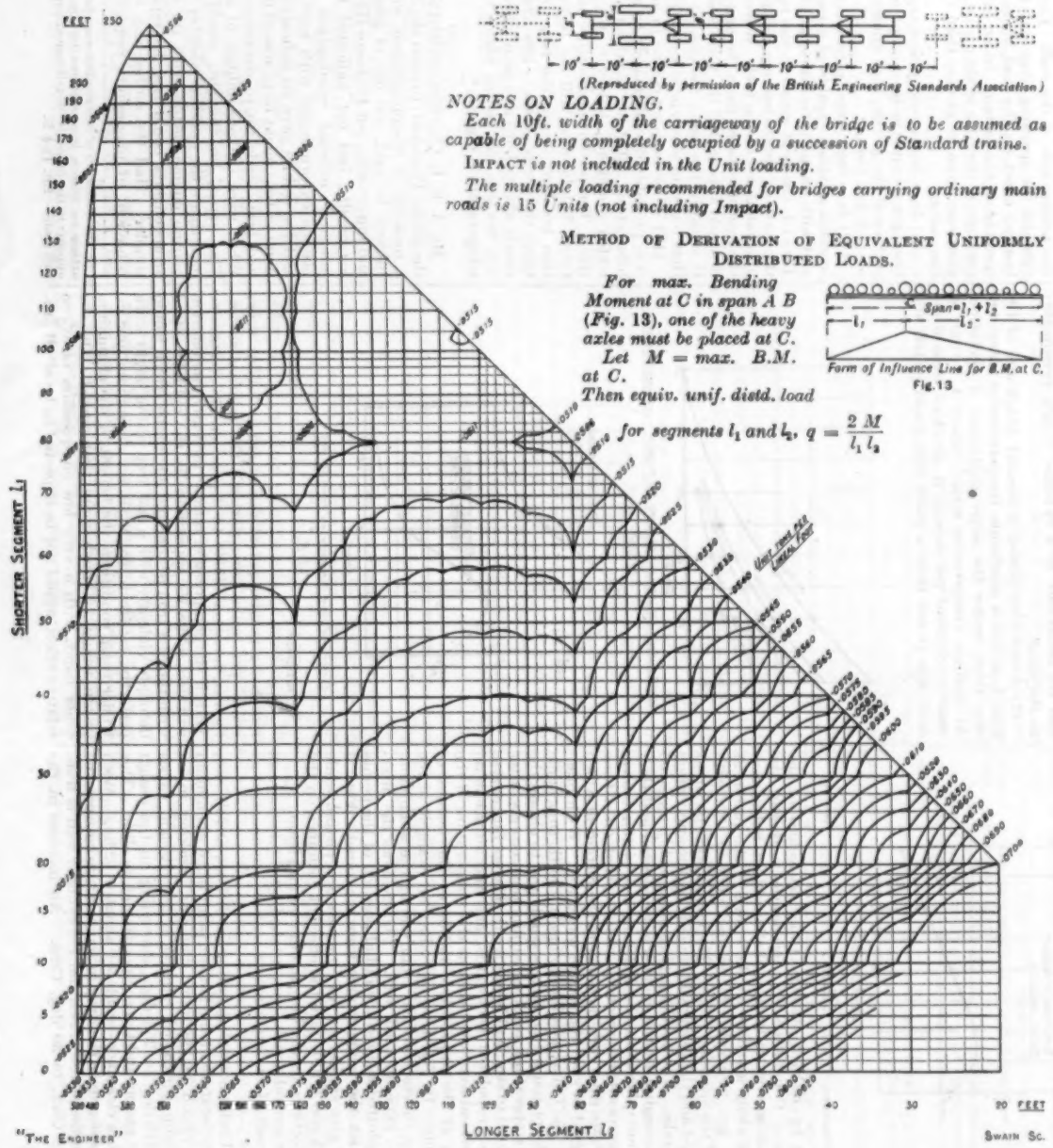


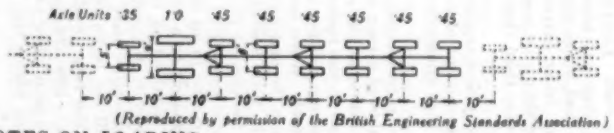
Fig.7 "THE ENGINEER" SWAIN Sc.

Approximation to Maximum Shearing Force at every Point of Span.—On span A B erect A D = max S.F. at abutments and C E = max. S.F. at centre. Draw straight lines D E and E B.

The max. S.F. at every point of the span due to the loading is closely approximated to by Fig. 7.

BRITISH STANDARD UNIT LOADING FOR HIGHWAY BRIDGES—CHART B, FRAMED GIRDERS





(Reproduced by permission of the British Engineering Standards Association)

NOTES ON LOADING.

Each 10ft. width of the carriageway of the bridge is to be assumed as capable of being completely occupied by a succession of Standard trains.

IMPACT *is not included in the Unit loading.*

The multiple loading recommended for bridges carrying ordinary main roads is 15 Units (not including Impact).

METHOD OF DERIVATION OF EQUIVALENT UNIFORMLY DISTRIBUTED LOADS.

For max. Bending Moment at C in span A B (Fig. 13), one of the heavy axles must be placed at C.

Let M = max. B.M. at C.

Then equiv. unif. distd. load for segments l_1 and l_2, $q = \frac{2\,M}{l_1\,l_2}$

Form of Influence Line for B.M. at C.

Fig.13

USE OF CHART B.

The chart gives equivalent uniformly distributed loads, in Unit tons per lineal foot, for maximum Bending Moment, due to one line of Standard Unit trains in succession, at all points of spans from 40 to 500 feet. l_1 and l_2 are the two segments into which the span is divided by the point considered.

The general application of these uniform loads to the determination of all stresses which may be represented by triangular influence lines is explained in the text. Formulæ for maximum Chord and Web stresses in framed Girders, and for max. Pier Reactions, are given below :—

(1) MAX. CHORD STRESSES.

Max. Bending Moment at C (Fig. 8) = $\frac{1}{2}\,q\,l_1\,l_2$, where q = equiv. unif. dist. load, in tons per foot run, for segments $l_1 = A\,C$ and $l_2 = C\,B$.

Let d = lever arm of Chord member D E about C, then max. stress in member $D\,E = \frac{1}{2}\,\frac{q\,l_1\,l_2}{d}$ . . . . . (1)

(2) MAX. WEB STRESSES—PARALLEL BOOMS.

Max. Principal Stress (Tensile) in Web member D C (Fig. 9) =

$$\frac{1}{2}\,\frac{q\,l_1\,l_2\,\sec\theta}{p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2A)$$

where q = equiv. unif. distd. load for segments l_1 and l_2.

Max. Reversed Stress (Compressive) in member D C =

$$\frac{1}{2}\,\frac{q^1\,l_1^1\,l_2^1\,\sec\theta}{p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2B)$$

where q^1 = equiv. unif. distd. load for segments l_1^1 and l_2^1.

(3) MAX. WEB STRESSES—NON-PARALLEL BOOMS.

Max. Principal Stress (Tensile) in Web member D C (Fig. 10) =

$$\frac{1}{2}\,q\,l_1\,l_2\,\frac{\sec\alpha}{r\,p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3A)$$

where q = equiv. unif. dist. load for segments l_1 and l_2.

Max. Reversed Stress (Compressive) in member D C =

$$\frac{1}{2}\,q^1\,l_1^1\,l_2^1\,\frac{\sec\alpha}{p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3B)$$

where q^1 = equiv. unif. dist. load for segments l_1^1 and l_2^1.

For member F E, max. Compressive stress $= \frac{1}{2}\,q\,l_1\,l_2\,\frac{\sec\alpha^1}{p}$ . . . . (3C)

and max. Tensile stress $= \frac{1}{2}\,q^1\,l_1^1\,l_2^1\,\frac{r\,\sec\alpha^1}{p}$ . . . . . (3D)

where q and q^1 in (3C) and (3D) have the values as noted under (3A) and (3B).

(4) MAX. PIER REACTIONS.

Max. Pier Reaction at C (Fig. 11) $= \frac{1}{2}\,q\,(l_1 + l_2)$ . . . . . (4)

where q = equiv. unif. dist. load for segments $l_1 = A\,C$ and $l_2 = C\,B$.

(5) MAX. END REACTIONS.

Max. End Reaction for span A B (Fig. 12) $= \frac{1}{2}\,q\,l$ . . . . . (5)

where q = equiv. unif. distd. load for segments $l_1 = o$ and $l_2 = l$.

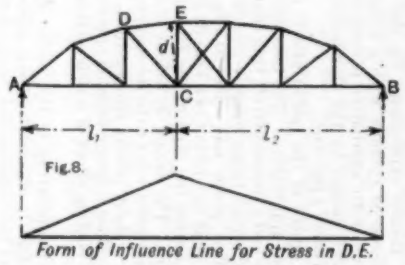
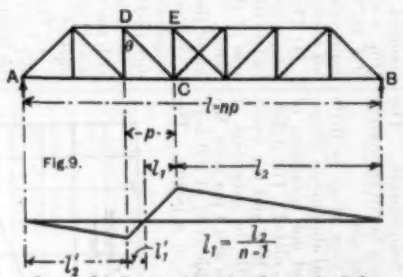
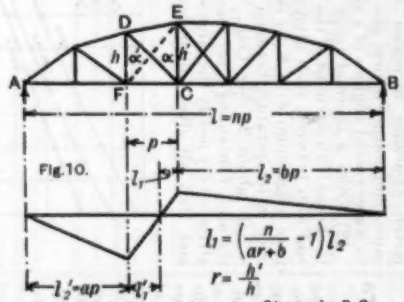


Fig.8.

Form of Influence Line for Stress in D.E.



Form of Influence Line for Stress in D.C.



Form of Influence Line for Stress in D.C.

l_1 and l_2 = the two adjoining spans

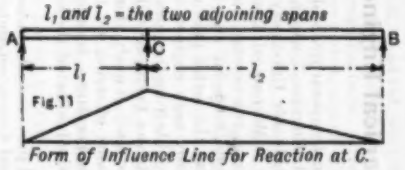


Fig.11

Form of Influence Line for Reaction at C.

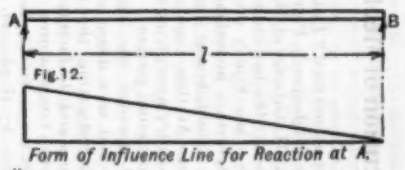


Fig.12.

Form of Influence Line for Reaction at A.

"THE ENGINEER" SWAIN SC.

Institution of Mechanical Engineers

THE paper entitled "Piston Temperatures and Heat Flow in High-speed Petrol Engines," which Professor A. H. Gibson, of Manchester University, presented before the Institution of Mechanical Engineers in London last Friday evening, represented an outcome of certain investigations made at the Royal Aircraft Establishment during the latter part of the late war. At that time many aero engines in use in this country were giving trouble from the burning of their aluminium pistons. It was Professor Gibson's task to discover the cause and remedy for this trouble, and as a direct means of doing so, he set about investigating the temperatures reached by the pistons and the factors which affected the magnitude of such temperatures.

Similar measurements had previously been successfully made by Hopkinson and Coker, separately, on internal-combustion engines of large diameter—up to 12in.—and slow speed—up to 200 revolutions per minute. These experimenters used thermocouples with junctions at different points on the crown of the pistons, the leads to the millivolt meter being taken off by way of links providing a flexible connection. Professor Gibson attempted to repeat this method on the small bore high-speed engines with which he had to deal, but almost at once got into difficulties from the fact that the thermocouple leads would not withstand the greatly increased inertia forces thrown on to them. One trial extending to 20 minutes under steady conditions was alone successful, and served to confirm the results obtained by the indirect method of arriving at the temperatures which was eventually adopted.

Details of the final method employed are not given in Professor Gibson's paper, but they may be found in Report No. 13 of the Light Alloys Sub-Committee,

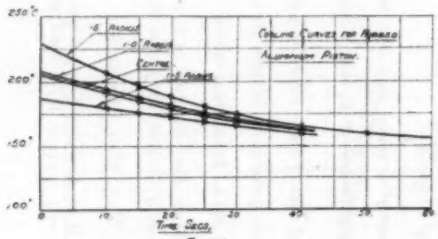


FIG. 1.

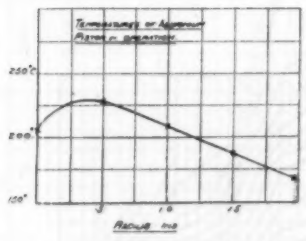


FIG. 2.

issued by H.M. Stationery Office on behalf of the Advisory Committee for Aeronautics. Briefly the method was as follows:—Shallow blind holes were drilled along a radius on the crown of the piston at about ¼in. intervals, the radius lying in line with one of the sparking plugs. The engine was run up at full load and then stopped suddenly by the application of a brake. The sparking plug was quickly removed and through it thermocouples were inserted and their junctions placed in the holes in the piston crown. The temperatures recorded were plotted on a time basis, zero time corresponding to the instant at which the signal to stop the engine was given. With practice it was found possible to insert the thermocouple into the piston within three seconds and to obtain the first temperature reading within ten seconds after the signal to stop had been given. The cooling curves were extrapolated backwards, and the intercept on the vertical axis was taken as the temperature of the piston at the appropriate radius at the instant of stopping. In Fig. 1 we reproduce an example of the cooling curves obtained from one of the aluminium pistons experimented with. Fig. 2 shows the intercepts plotted against the radial position of the points at which the temperatures were measured. Figs. 3 and 4 give similar curves for a cast iron piston, while Figs. 5 and 6 illustrate the effect of clearance on the temperatures reached by an aluminium piston.

The general conclusions reached by the author as the result of his experiments may be summarised as follows:—

(1) Under normal operating conditions, at full load, the temperature at the hottest point of an aluminium alloy piston of 100 mm. diameter, working in an aluminium air-cooled cylinder of good design, varies from 210 deg. to 250 deg., depending on the design of the piston and the composition of its alloy. This is with a clearance—cold—of about 0.025in. With such a clearance the drop in temperature between the edge of the piston crown and the cylinder wall is from 25 deg. Cent. to 30 deg. Cent. An increase in the piston clearance increases its temperature. The same temperature figures also apply fairly accurately to water-cooled engines of a similar size.

(2) From a thermal point of view there is little to choose between most of the usual aluminium alloys, and also between such alloys and one consisting of pure magnesium with 3 per cent. nickel. The difference in temperature between the best and the worst is only about 25 deg. Cent. With the exception of the alloy containing 8 per cent. Cu and 1 per cent. Mn all have very nearly the same conductivity at 200 deg., and they all give similar results in a piston. The

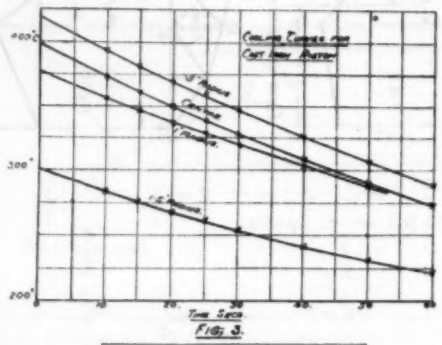


FIG. 3.

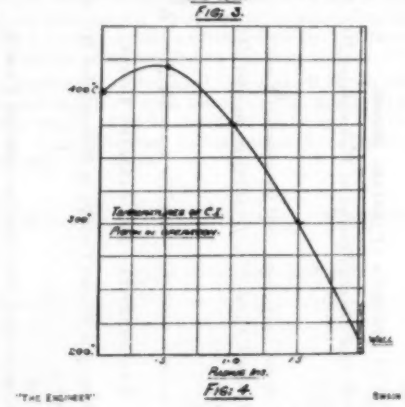
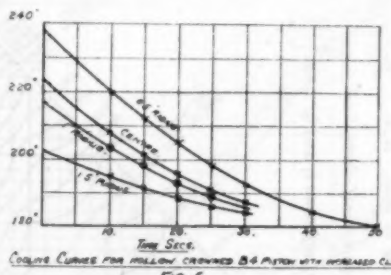


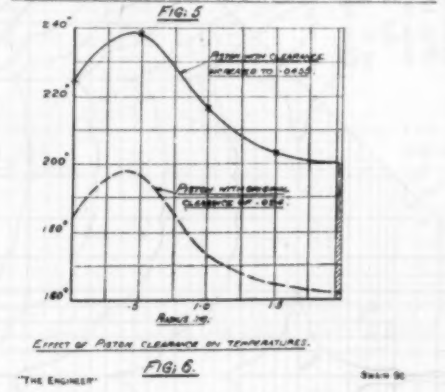
FIG. 4.

Cu-Mn alloy has a lower conductivity and gives a hotter piston. It should be noted that if this alloy is annealed at 450 deg. Cent. for a short time, its conductivity becomes as high as that of the other alloys and its behaviour in a cylinder would presumably be the same.

(3) A cast iron piston of normal design and of 100 mm. bore has a maximum temperature of about 440 deg. Cent. under the same conditions of operation. At medium compression ratios—about 4.7—and at 1800 revolutions per minute it develops some 6 per cent. less power than a good aluminium piston and



Cooling Curves for Hollow Crowned B.4 Piston with Increased Clearance
FIG. 5.



Effect of Piston Clearance on Temperatures.
"The Engineer"
FIG. 6.

requires a greater petrol consumption—about 8 per cent.—per brake horse-power. The relative advantage is, however, likely to depend on circumstances. Thus if the compression ratio is increased, detonation will first make its appearance in the cylinder fitted with the cast iron piston, and a cylinder which would detonate violently with a cast iron piston might work perfectly satisfactorily with an aluminium piston. Under these conditions the benefit of the aluminium piston would be much more pronounced. On the other hand, with a very low compression ratio the relative effect would not be expected to be at all pronounced. Recent experiments by the author on a 3½in. water-cooled cylinder with a compression ratio of 4.26 fitted with alternative pistons show that the improvement caused by the aluminium piston does not exceed some 2 per cent.

(4) The design of the piston affects its maximum temperature appreciably. The best piston examined had no ribs and a comparatively thin centre, the thickness of the crown being roughly proportional to the radius. This piston was some 20 deg. cooler than one of the same weight but of a heavily-ribbed design.

(5) Perforating the skirt of the piston increases its temperature. The saving in weight is so small that such perforations are not to be recommended.

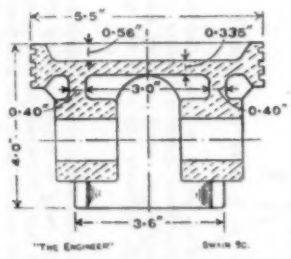
(6) The highest piston temperatures are attained with the weakest mixture capable of giving maximum power, the cooling effect of a rich mixture being very marked.

(7) The temperature of the piston appears to be only very slightly affected by the compression, within the limits of the experiments, being slightly less with the higher compression ratios.

(8) The effect of spark advance on piston temperature is not very pronounced, the highest temperatures being obtained with the minimum spark advance.

(9) In a piston of the slipper type—Fig. 7—in which the gudgeon-pin bosses are carried by lugs joining the piston crown, a considerable amount of heat is transmitted down these lugs, and the temperature

FIG. 7.—*5½-inch Slipper-type Aluminium Piston.*



gradient across the crown is much less than in the normal type of skirt piston. At the same time, owing to the reduced bearing surface, the drop in temperature between the edge of the piston and the wall is greater than in a skirt piston.

(10) In an air-cooled cylinder, the hottest point of the piston is not at the centre, but at a point nearer the hottest side of the wall. Even in a water-cooled cylinder the sparking plug may have a very marked heating effect on the wall in its vicinity and consequently on the piston. In an extreme case the temperature at the edge of the piston nearest the sparking plug may even be greater than that at the centre of the piston.

(11) In a high-speed petrol engine at 2000 revolutions per minute the fluctuation of temperature in the surface of the piston, if of aluminium, is of the order of ± 5 deg. Cent.

(12) In a high-speed petrol engine working on the weakest mixture capable of giving maximum power, and with an air/petrol ratio in the neighbourhood of 13·5 : 1, the heat given to the piston and flowing to the walls is approximately 3·5 per cent. of the heat of combustion of the fuel. When account is taken of the heat dissipated from the under side of the piston, it would appear that the total heat given to the piston is sensibly the same fraction of the heat supply as that found in slow-speed gas engine tests.

(13) When burning occurs in an aluminium piston, it is probably due ultimately to a local breakdown of lubrication, following overheating to a temperature which would not, however, in itself, prove destructive. The piston temperature may rise to 300 deg. Cent., but burning will not begin until, the lubrication breaking down, the heat produced by friction raises the temperature to 500–530 deg. Cent. Pistons nearly always burn at a point close to their edges, and not towards the centre where the normal working temperature is highest.*

Mr. A. E. L. Chorlton, invited by Sir Henry Fowler, the acting President, to open the discussion, expressed a measure of disappointment with the paper. The subject, he said, was one of great practical interest and importance, but Professor Gibson, beyond stating his results, had not indicated their application to practical internal combustion engineering. The pistons experimented with were of small diameter, and the results gave no indication of how far aluminium pistons might be increased in size. Such pistons had been made up to diameters of 14½in. to 18in. What were the possibilities of going beyond 20in.? The paper, he thought, would lead designers to investigate the question whether the common type of marine engine piston with its complicated cooling arrangements could not be replaced by something simpler. Had the author any experience with the behaviour of magnesium pistons? He had tried a

* The attention of our readers may be usefully directed to an article on piston temperatures by Dr. W. Rosenhain, which appears in the monthly Metallurgical Supplement accompanying this issue.—ED. THE E.

magnesium alloy piston of 8¼in. diameter. Its life was found to be short and except for its light weight, which permitted the adoption of very high speeds, it had no great advantage. He would suggest that useful results might accrue from the employment of a copper alloy for internal combustion pistons. Did Professor Gibson believe that aluminium alloy would find a wider use in internal combustion engines than its employment for the pistons? One such possible employment was for the cylinder heads which frequently failed as a result of the stresses set up by the heat flow. He was puzzled to understand why Professor Gibson did not take account of the heat flowing through the piston rings. The rings were in direct contact with the cylinder walls, and it would therefore appear that the greatest heat flow took place through them and not through the lands on the skirt to which Professor Gibson had confined his argument. That the rings did affect the matter was suggested by the fact that of three types of piston illustrated in the paper, the lowest temperatures were recorded in connection with one having three rings, while the two others had but two rings. Large pistons, in his experience, nearly always burnt near the centre and not towards the edge. As a consequence, they had generally to be forged, and not cast, so as to avoid porosity and the increased tendency to burn which porosity caused.

Captain R. O. King, dealing with the inferiority of cast iron pistons as compared with pistons of aluminium alloy, suggested that it might be possible that with small diameter pistons in engines running at less than their full power, the position might be reversed. At less than full power the hotter cast iron piston might have a decided advantage over the cooler aluminium piston.

Captain J. C. Briggs expressed the hope that the author would continue his experiments. It was desirable to discover the effect of perforations, not only in the skirt of the piston but also in its bearing surfaces. The effect of variation in the materials used for the pistons was worthy of further study, and it might be advantageous to investigate the behaviour of forged aluminium for such purpose. In order to study properly Professor Gibson's results regarding the effect of the compression ratio on the piston temperatures, it would be desirable if he would state what fuel was used and whether it was the same throughout all the tests.

Mr. J. F. Alcock agreed with Mr. Chorlton regarding the part played by the rings in conducting the heat from the piston to the walls. Regarding the cooling curves, he raised the question whether the holes in which the thermocouples were placed did not become coated with a film of carbon and whether such film might not have a considerable effect on the temperatures recorded.

Major E. B. Wood said that the paper, together with Professor Gibson's earlier paper on the temperatures of valves, showed how much there still remained to discover in connection with the high-speed internal combustion engine and the conditions prevailing inside its cylinders. He would like to know what would be the temperature drop between the piston and the cylinder walls of an engine if the pistons were without rings. Such information would be useful in connection with the design of sleeve valve engines. In the tests conducted on a water-cooled engine, he was surprised to find how great the difference was between the temperature of the cylinder liner—say, 160 deg. to 220 deg. Cent.—and the outlet temperature of the circulating water—about 60 deg. Cent.

Engineer-Captain Philips, dealing with Mr. Chorlton's remarks regarding the limit of diameter for aluminium pistons, said that considerable experience at sea and in the Admiralty Laboratory showed that one of the principal limitations to increase of size was not the difficulty of accommodating the heat flow, but the fact that after a certain size was reached the piston distorted archwise and broke the rings. If this difficulty were overcome by giving increased vertical clearance to the rings in their grooves, powerful inertia forces were called into play, which hammered out the lands between the grooves and resulted in the piston having but a short life. Attention had also to be paid to the clearance provided on the skirt. If this clearance were too large "slap" developed, and if it were too small the piston seized and tearing began. This point might be borne in mind in discussing the copper alloy pistons suggested by Mr. Chorlton. Such pistons, he thought, would probably bite at an early stage in their history, unless considerable clearance were provided. Another difficulty encountered with aluminium pistons of large diameter was the loss of lubricating oil past them. If the clearance were sufficient to permit the piston to run satisfactorily for a long time, loss of lubricating oil was inevitable. Such loss was objectionable, not only on the score of expense, but also because the oil carbonised on the exhaust valves and caused the spindles to seize. He agreed with those speakers who believed that the great percentage of the heat transference from the piston to the cylinder walls was effected by way of the rings, and not through the skirt and the intervening film of oil.

Wing-Commander Cave-Brown-Cave remarked that the method adopted for measuring the piston temperatures was a very courageous one, but admirable technique had enabled it to be successfully applied. The suggestion made in the paper regarding the cause of the burning of pistons—namely, that there was a local breakdown of lubrication which resulted in the addition of heat to that delivered through the piston by the combustion of the fuel—provided a satisfactory explanation of the great difference between the temperature reached by the piston during its operation and the temperature corresponding to the melting point of aluminium. It would be interesting to know if the burning of aluminium pistons occurred mostly at the ends of the diameter at right angles to the gudgeon pin. In the direction parallel with the gudgeon pin there was not a great amount of pressure between the piston and the wall, and hence local failure of lubrication was less likely to occur in this direction than in the other. He differed from Mr. Chorlton in so far that in his view the paper was exactly what the designer wanted, for it disclosed general principles and did not attempt to lay down practical details.

Mr. Pendred expressed surprise that the experimental method adopted gave satisfactory results. In no case could the temperature of the piston at the moment of explosion be directly determined. Did not the phase in which the engine happened to stop affect the temperature recorded? Professor Gibson had measured the surface temperature of the piston on the combustion side. Had he made any measurements of the temperature on the crank side in order to establish the temperature gradient through the piston? It was not sufficient to consider the surface temperature alone, for the body temperature was the factor affecting the strength of the piston.

Mr. E. W. Moss asked whether the temperature measurements were always taken with the piston in the same position on its stroke. If the position varied it would seem that the rate at which the piston cooled would be different, and that fact would lead to discordant results.

Sir Henry Fowler, before calling upon Professor Gibson to reply, dwelt upon the very ingenious way in which he had tackled his difficult problem. Several methods of measuring the temperature of the piston crowns had been tried before the simple plan outlined by the author had been adopted. If that method were not right it was certainly not very far off being right. When aluminium pistons were first tried the phenomenon of burning was a very important matter. He regretted that it had not been found possible to exhibit a burnt piston at the meeting, but he could describe the effect as resembling the attacks of the death-watch beetles on the old timbers of Westminster Hall roof.

Professor Gibson, replying, said that the criticism of his paper might have been much more destructive than it had been. As regarded Mr. Chorlton's objection to the paper on the ground that it did not deal with practical applications to a sufficient extent, he said that, on the contrary, he had felt that as a mere University professor he had been merging almost indelicately on the practical, and had even incurred the risk of being told by practical people to mind his own proper business. Alloys of copper used for pistons, as suggested by Mr. Chorlton, would be found to possess bad abrasive properties, to be extremely heavy, and to have a very low thermal conductivity. It had at one time been proposed to employ cylinders of phosphor bronze, an alloy of copper. Cast iron, aluminium alloy and phosphor bronze cylinders made from the same pattern were tested, and it was found that the phosphor bronze example was the hottest. On examination at the National Physical Laboratory, the conductivity of the metal was found to be worse even than that of cast iron. He believed that aluminium alloy was the outstanding material to employ for cylinder heads. It was already used very largely, almost, in fact, exclusively, for that purpose by the aero-engine makers of this country and the United States. He had made no measurements of his own of the heat flow through the piston rings, but the mere fact that the clearance provided on the piston had a definite effect on the piston temperature showed that a certain amount of heat did go through the skirt as distinct from the rings. In any event, whether the heat went through the rings or the skirt, made no difference to the temperature of the piston crown. As regarded the limits of size for aluminium pistons, Mr. Windeler, of Mirrlees, Bickerton and Day, had stated at the Manchester meeting on the previous evening that a 17in. aluminium alloy piston had been running in a Diesel engine for some time without trouble. Captain King's remarks regarding the superior efficiency of cast iron pistons were true in certain circumstances if the engine were running on part throttle. In a motor car engine the best results, as was well known, were obtained if the jacket water were at about 130 deg. Cent. If the temperature were below this point the warming up effect of the cast iron piston would be beneficial. He had made no tests with either duralumin or Y alloy pistons, but given the same thermal conductivities the same results should be obtained. The same fuel, aviation spirit, was used throughout the tests. Had there been any carbon deposit on the piston crown the temperature readings, as Mr. Alcock had suggested, would have been affected. The effect in his experiments could only have been negligible, for in every case the pistons were run for five hours and then stopped, and the thermocouple holes carefully cleaned out. The readings were taken in 5 to 15 minutes after restarting, so that what carbon deposit there could have been must have been very small. The thermocouples, he added, were warmed up to the anticipated temperature before they were inserted through the sparking plug hole. The rate of cooling of the pistons was very slow, about 15 deg. in 60 seconds, so that during the 10 seconds elapsing before the first reading was made, the total drop in temperature could only have been small. The points on the curves represented means of 10 to 12 tests, the repeated measurements of which agreed to within ± 5 deg. Cent. Replying to Wing-Commander Cave-Brown-Cave, he stated that among the burnt pistons taken from three different types of engine made by three different firms, 95 per cent. showed the burning effect at right angles to the line of the gudgeon pin. The phase in which the piston stopped had very little effect on the temperature of the crowns, he remarked in reply to Mr. Pendred; the fluctuation of the temperature throughout the cycle was quite small, amounting, as stated in the paper, to about ± 5 deg. Cent. He had not measured the temperatures on the underside of the pistons, but the heat flow through the pistons could readily be calculated, and the drop in temperature, he found, was not above 20 deg. Cent., so that the mean value of the body temperature was only some 10 deg. less than that on the surface. Replying to Mr. Moss, he stated that the piston was always stopped in the same position, namely, at the upper dead centre.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

BRITISH IMPORTS, EXPORTS AND EMPLOYMENT.

SIR,—(1) Although a life-long Conservative, I am very much opposed to the Safeguarding of Industries Bill. I believe in Fair Trade and equal treatment for all industries and their workers.

(2) As British goods are penalised practically throughout the world, we should adopt some form of retaliation. It is essential, in order to retain the wealth of Great Britain, to keep our exports of all descriptions in excess of imports.

(3) I suggest the following remedy, which appears to me fair to the whole community:—Commence with an *ad valorem* import duty of 12½ per cent. on all foreign and 10 per cent. on all colonial imports, excepting gold, and give a bonus of 10 per cent. on all exports, excepting gold.

(4) Make a rule that the duty and bonus will not be altered above 1 per cent. every three months, to avoid any dislocation of trade.

(5) Every three months the duty and bonus will come up for revision according to the trade balance and unemployment statistics.

(6) A simple duty and bonus of this description probably could be handled by the shipping companies transporting the goods.

(7) We alter our Bank rate to regulate the import and export of gold, so why not use the duty and bonus to regulate the import and export of goods.

(8) At first the cost of living might be slightly increased, but this should be balanced by more regular employment; also the Customs duties on tea, sugar and tobacco, &c., might be reduced.

(9) To prevent fraud, the export bonus would be paid on the declared cost at works, home consumption value or selling price delivered f.o.b., whichever the lowest.

(10) *Shipbuilding.*—I suggest that all ocean-going ships built in Great Britain should be treated as exports.

(11) If foreign countries reduced their import duties our exports would increase and our duty and bonus would automatically be reduced, and *vice versâ*, and eventually it might lead to international free trade.

(12) Free Traders cannot complain that this system would penalise commerce, as most of the money collected on imports would be used to subsidise exports.

(13) In my opinion, there is practically as much labour in the production of £100 worth of steel, wheat, cutlery or gloves. Manufactured goods should in each case be assisted on an equal basis, or it is very unfair to the different workers and employers. The present Safeguarding Bill will only create more sheltered trades at the expense of the unsheltered ones.

(14) No Free Trade country can face protected competition unless its workers are paid less or work harder. I find that most Free Trader producers to-day are working mainly for the Government, municipalities or British railway companies, and they raise a great outcry if they do not receive at least 50 per cent. preference over continental producers. This sentimental protection is given to our friends at the expense of the unsheltered producer in both home and export trade, who has to compete against the whole world.

(15) As managing director of an English engineering works and also of an export merchant company, I am interested equally as a manufacturer and as a merchant, and I submit the above policy would benefit all trades, including agriculture.

Leeds, December 14th, 1925. W. T. HUDSON.

COMBUSTION CHAMBERS FOR PULVERISED COAL.

SIR,—The leading article in last week's issue of THE ENGINEER, under the heading of "Furnaces and Combustion," undoubtedly foretells the trend of development in furnace design, more particularly in regard to pulverised fuel applications.

In the columns of another technical journal the writer recently entered into some correspondence on this subject, his conviction being that, as you point out, "some factor has been left out of consideration," which when realised will introduce a very considerable reduction in combustion chamber area.

In those series of letters it was contended by one authority that any reduction in combustion area in regard to pulverised coal firing "would be a retrograde step."

The hidden factor to which you refer is in all probability the influence of "pulsations" transmitted to the combustible mixture of coal and air, either during or prior to combustion. Experiments conducted on these lines disclosed a phenomena described by the French engineer whom you mention, and further

investigations have been recorded by his compatriot, J. Audibert

In a forthcoming number of an industrial journal the writer has once again advanced the suggestion that the size of combustion chamber for the application of pulverised fuel must be reduced before the cost of those necessary extensions or alterations to furnaces can be considered by the larger users of coal in Great Britain—the owners of industrial works. That this result will be accomplished at an early date is highly probable.

The work of an American company has shown the liberation of considerably over 100,000 B.Th.U. per hour per cubic foot of combustion area. This advance in the science of combustion is substantiated also in Great Britain by the tests recently published concerning the "pregasification" cycle.

As stated by the writer in his article elsewhere, progress in this direction is bound to follow upon due consideration of factors such as:—(*a*) Intimate initial mixing of the fuel with its air supply by means of specially constructed burners; (*b*) turbulent combustion within a confined area; (*c*) pregasification of the fuel and the subsequent combustion of the gas; (*d*) a combination of (*a*), (*b*) and (*c*).

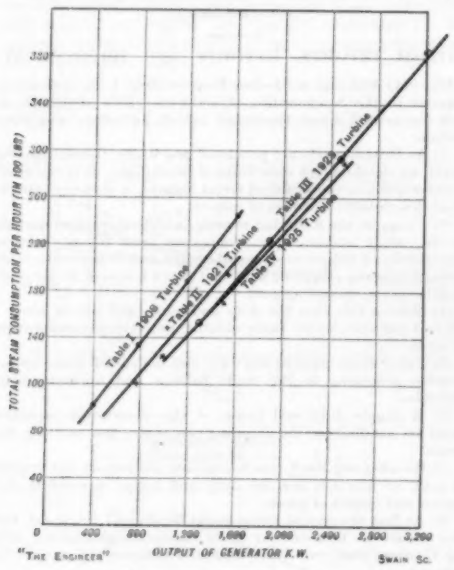
With the advent of the small combustion chamber pulverised coal firing will receive a very decided impetus in our industrial circles. The other necessary requirement—an efficient and reliable self-contained pulverised unit—is wellnigh an accomplished fact.

LEONARD HARVEY.

London, January 25th.

IMPROVED STEAM TURBINES.

SIR,—Although I have no interest in the design, construction, or installation of steam turbines, there will no doubt be many readers like myself interested in the results given on pages 105–6 of your issue of the 22nd inst., showing the improvements that have taken place in the steam consumption of steam turbines over a period of seventeen years, and I have prepared, for my own edification, a diagram showing the combined results of the



four turbines referred to, showing total steam consumption against output, and find that, as might be expected, they follow the Willans straight line law, so I enclose a copy in case you think it of sufficient value to reproduce in your columns.

DANIEL ADAMSON, M.I. Mech. E. &c.

Hyde, January 26th.

THE BUSINESS SITUATION IN ENGLAND.

SIR,—Your correspondent, Mr. Dean, of October 30th, caused me to recall that I, too, am of English ancestry; but as I had no choice in the matter I shall pass over discussion of it, believing that luck or lack of it reacts little to one's credit or discredit.

By this time, surely, the insidious institution of the "dole" has been abolished in our common Mother Country, for the newspapers and Parliament have had time to adjust the matter. As one who does not belong to the so-called "working classes," I fervently pray for education among the remainder of the "classes," where it is sorely needed also. As an American who has not just returned from England, and sees no prospect of returning or arriving, I nevertheless feel qualified along with other self-constituted critics to set you right in several very important matters.

"The beauty of machinery is more in shapes and proportions than in finish." It is lamentable that your correspondent did not add "in my opinion," for it takes the mind of an engineer to see beauty in a locomotive. If you paint them elaborately in Britain to hide their ugliness, something of the same spirit was back of the designing of long trousers. Fortunately for Americans, our locomotives are mostly heard and not seen. I regret the advantage your correspondent has over me, for he admits having seen an attempt at beautification.

Moreover, the thought has further ramifications. The windows in Phillips Brooks' church do not pay dividends; nor the scores of monuments both there and here (intentional). No matter how beautiful some may think an article, thousands will disagree. If a locomotive can move, it may come where we are, and therefore please urge some Britisher to write to the makers of ours or send them a paint brush. But Englishmen must get sufficient exercise laughing at our criticisms; here about all there is left to do is to write to the Editor—but I must hurry on to point out your imperfections. If I could but visit you, it would be so much easier—note that I did not say "should."

Please hereafter make your buildings plain and leave off all statuary, busts, &c. Did you not know that frills cost money. A sculptor, in other words, does not work for nothing. Scrutinise carefully all Government expenditures, or do not rest until a committee is appointed; for we do it here. If the King objects, elect a new one next time, and look out for astonishing wastes of money in the purchase of cloth for your mail bags. Send some of your silverware designers to us, for we have the last word in styles. We do not care that you may prefer yours; ours are better. That is indisputable, of course. If you will establish that what we use is perfect, you will end this nefarious delusion.

We read that the tenacity with which England clings to the ton, quarter, and hundredweight, pound, shilling and pence, is amusing. Your correspondent did not add that the American adheres with slipping fingers to tons, pounds, grams, grains, ounces; and that he does it in C.G.S., Troy and some others. It would not do at all for us to reduce our five-dollar bill to the value of your pound. The world standards are those in use here. Of course. Make your pound exactly equal to five dollars or to twenty francs.

If you will pay my expenses, I can write a letter on my return that will do it up better than your correspondent did; but he probably did not mean to be funny, and make thinking Americans appear more ridiculous than they really are.

Above all, avoid all displays which tend to show extravagance, such as cakes in windows. The few months that I spent in Boston left the vague impression of almost nothing in the windows—but this may be extravagance. Perhaps Boston is not accustomed to cakes because of other food I shall not stoop to name. Here in Washington we have hundreds of cake-eaters.

And as for marmalades and jams, your correspondent notwithstanding, we have them by the ton, although we might easily "get along very well without them." But we don't, for the same reason you have. It is, of course, very stupid of you as a nation to drink that which makes you sleepy and dull; and if you would stop this practice you would be bright and wide-awake like us. And, moreover, it must cost a lot of money to serve tea at four o'clock. This money ought to be sufficient for all the cloth necessary for mail bags, with some left over for designing new tableware. As an American, I earnestly request that these items be attended to at once.

W. E. BAILEY.

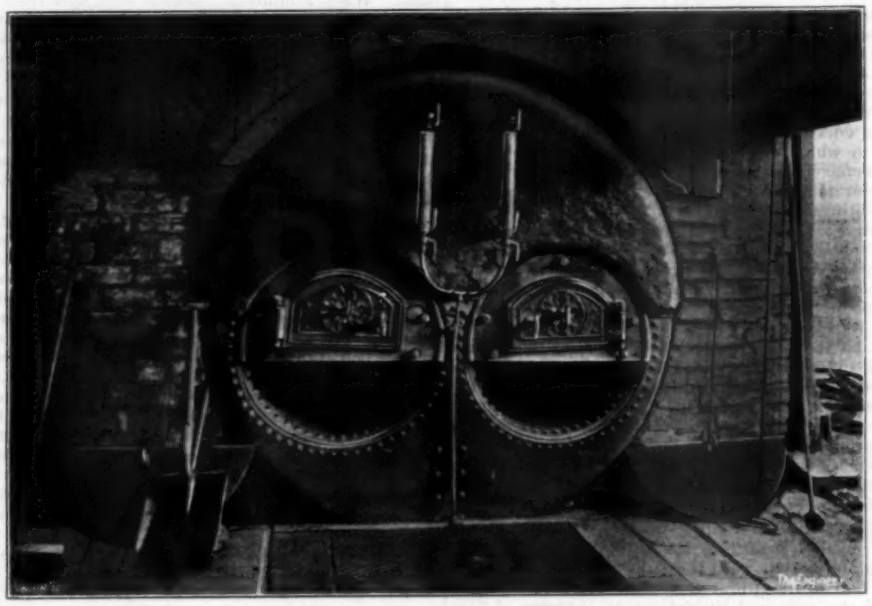
Washington, D.C., January 11th.

P.S.—And don't you think it is inconsistent to drink yourself sleepy and dull, and then drink yourself awake? We have solved the problem as the whole world should solve it.

P.P.S.—Of course.

AN OLD LANCASHIRE BOILER.

SIR,—We enclose herewith a copy of a photograph which may be of interest to your readers. It shows a boiler of the Lancashire type made by our firm in 1853, and still working night and day in 1926. This boiler is in a factory on the Clyde side, about halfway between Glasgow and Greenock. It is now regularly inspected by a boiler insurance company, although none of these companies were in existence when the boiler was made, and the proprietor reports that he has never had an adverse report on the boiler. Further, the boiler has never required any repair since it was set to work.



LANCASHIRE BOILER CONSTRUCTED IN 1853 AND STILL AT WORK

Although now working at a low pressure, we think the record of this boiler's service is unique. The boiler is, of course, entirely constructed of iron plates, steel plates being unknown when it was made, and this, of course, to a certain extent doubtless accounts for its long life, such plates being less subject to corrosion than steel boiler plates. This was one of the first Lancashire boilers to be made with the ends flanged in to meet the shell. The hand flanging of these ends reflects great credit on the old-time boilermaker who did this work, and its appearance is quite equal to any flanging done in the best of our modern machines.

As the photograph shows, the end plate is in two parts, the reason, of course, being that a plate large enough for the end could not at that time be rolled.

The shell consists of some thirty small plates, three to the circle, as compared with the modern boiler in which the shell would consist of three plates only, each rolled to a complete circle.

For WILSON BOILERMAKERS, Ltd.,
W. J. WILSON, Director.

Glasgow, January 14th.

A RECORD was broken recently at the Queenstown reduction works of the Mount Lyell Company, when 1030 tons of blister copper was produced in one month. The previous record was about 945 tons.

SIXTY YEARS AGO.

IN contrast with the proceedings between the National Union of Railwaymen and the companies' representatives, which have been the subject of some anxiety within the past few days, we have a brief picture in our issue of January 26th, 1866, of how similar disputes were handled sixty years ago. An effort was at that time being made to unite in one society all the guards, signalmen and switchmen on the railways of the United Kingdom, an effort which, we believe, ultimately led to the formation of the present union. At a meeting held at Paddington to consider the movement and to discuss the redress of certain grievances, it was stated that memorials from the men had been sent in to the traffic managers of the various lines, with the request that they might be laid as soon as possible before the boards of directors. The memorials asked that the hours of labour should be reduced to eight per day from the twelve to eighteen—quite a common number on Sundays—then in force. It was also requested that the standard rate of wages should be made 30s. per week for "junction men" and 26s. for "straight-road men." Most of the boards replied through their traffic managers, and nearly all declined to act upon or recognise any memorial emanating from a society. It was added that the boards were, and always had been, willing to entertain the complaints of their own men, either as a body or in sections. When this position was laid before the Paddington meeting, it was decided to send in fresh memorials to the directors, signed only by the men in their respective employments. It was reported that on three of the Metropolitan lines the men, since the movement for union had been begun, had received advances in wages of from 1s. to 3s. per week. . . . Elsewhere in the same issue we recorded the beginnings of what was to produce a great tragedy. With the utmost astonishment, so we wrote, we had learned within the preceding day or two that Captain Coles had virtually been dismissed from the service of the Lords of the Admiralty because apparently he had addressed a letter to the editor of a daily journal advocating his system of constructing turret ships. This system was intended to provide vessels capable of competing with Mr. (Sir E. J.) Reed's broadside ships. The Admiralty had decided to build a turret ship on the Coles system, but, piqued apparently at his venturing to express his views in print, their Lordships intimated that Captain Coles would not, as at first intended, be permitted to inspect and advise upon the vessel's design. The turret ship so built was the Monarch. Captain Coles, backed by public opinion, sought to rival that vessel in the Captain, built by Laird's of Birkenhead in 1869. This vessel was intended to combine a low freeboard with the qualities of a sailing frigate. For a time she seemed to fulfil her designer's intentions, but on the night of September 6th, 1870, she capsized at sea, and of the 500 men on board her, all but eighteen lost their lives. This disaster is commemorated by a strikingly worded tablet in St. Paul's Cathedral.

BOOKS RECEIVED.

Report of the Food Investigation Board for the Year 1924. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. 6d. net.

Report on the Economic Conditions in Venezuela. By H. A. Hobson. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Materials Testing: Theory and Practice. By I. H. Cowdrey and R. G. Adams. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 7s. 6d. net.

The "Practical Engineer" Electrical Pocket Book, 1926. Edited by Conrad Arnold. London: The Oxford University Press, Falcon-square, E.C. 1. Price 2s. 6d. and 3s. net.

The Composition of Coal: Plant Cuticles in Coal. Paper No. 17 of the Safety in Mines Research Board. By V. H. Legg and R. V. Wheeler. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. net.

Railway Matters.

A PARTY of signal engineers from the Northern Railway of France has recently been in this country inspecting some of the automatic signal installations.

A SERIOUS buffer stop collision occurred on Saturday last, the 23rd inst., at Clevedon. On August 21st, 1920, a similar accident happened at the same place.

IN drawing attention to a change-giving device installed at St. James's Park Station on the Metropolitan District Railway, the railway company states that 65 per cent. of the travelling public need change.

AS a consequence of experiments made by the Great Western Railway Company in relation to Safety First, it was found that the number of accidents in the company's workshops at Swindon was reduced by 17·5 per cent., and among the permanent-way men over the whole system by 17·3 per cent.

A MESSAGE from Reuter's correspondent at Melbourne states, under date January 20th, that the Federal Government has introduced a Bill in the House of Representatives providing for the construction of a railway from Oodnadatta, South Australia, to Alice Springs, Central Australia, a distance of 279 miles, at a cost of £1,700,000.

THE incident of a passenger train running recently into a traction engine at a level crossing on a Scottish railway prompts us to mention the fact that the railway companies' rules aim at guarding against such a danger. The users of traction engines are requested to advise the nearest station-master before they want to cross the railway, and arrangements have then to be made for a flagman to be sent out in each direction to protect the operation.

TRAIN indicators for showing from which platform the next three, four or more trains will depart and the stations at which they will call, form—or should form—part of the equipment at all important stations. A recently designed indicator has been fixed on the St. John's Wood line platform at Baker-street, Metropolitan Railway. It is electrically operated from the signal-box by selective apparatus having 80 combinations for 24 stations and four platforms.

THE International Sleeping Car Company, with a view of augmenting the comfort and well-being of its passengers, has instituted an International Competition, open to all railway carriage building firms, as well as to private individuals, for new ideas with regard to the interior arrangement of sleeping cars, which may offer any marked improvement or advantage over those actually in use. All projects must be addressed, and should reach the Secretary-General of the International Sleeping Car Company, 42, Rue de l'Arcade, Paris, at the latest by April 30th, 1926.

ACCORDING to the figures which, as related in this column on January 15th, have been agreed to by the railways and traders, the London and North-Eastern carries the most freight traffic of the four grouped companies, and the Southern has the most passenger traffic. The agreed percentages are for freight traffic:—London and North-Eastern, 62·439; London, Midland and Scottish, 60·640; Great Western, 57·535; Southern, 26·371. For passenger traffic:—Southern, 73·629; Great Western, 42·465; London, Midland and Scottish, 40·441; London and North-Eastern, 37·570.

CONSIDERABLE concern is being displayed in Mid-Wales by the announcement that the Great Western Company contemplates closing five branch lines because they do not pay. The lines in question were built by the former Cambrian Railway, and it is argued that "as the Great Western acquired them at far less than their cost the company should maintain the existing services." We would, however, point out that Parliament, in its wisdom, placed the ownership of these lines in the hands of the Great Western; the transaction was not of the latter's seeking. Were the lines closed the public could take their complaint to the Railway and Canal Commission, which has then to decide if the action of a railway is reasonable.

CANNON-STREET STATION, yard and approaches are very badly laid out. They were put in when all trains between London Bridge and Charing Cross ran into Cannon-street and out again. Thus every train had to cross the path of other trains. Some of the lines, too, are laid out for right-hand and not the standard left-hand running. All that will have to be modernised if the electric services are to be a success, but it is now found that to do that whilst the traffic is running will not only considerably disorganise the trains, but necessarily take a long time to carry out. It is therefore officially announced that it may become necessary to close the station during the alterations, but the work can then be completed in about three weeks' time. The work will not be done before June.

TWO years ago, on the 21st inst., a strike of the greater number of the enginemen occurred because they refused to accept the award of the National Wages Board as to the guaranteed day, but those enginemen who belonged to the National Union of Railwaymen remained at work, as their Society accepted the award. On that occasion the representatives of the Associated Society of Locomotive Engineers and Firemen had signed the award and thus their men repudiated their signatures. Public opinion was very much with the National Union men for their loyalty to their leaders and condemned the enginemen for refusing to accept an award that bore their own representatives' signatures. Now, the exact opposite has happened. The meeting of the special delegates of the National Union of Railwaymen on January 21st, to consider the award of the National Wages Board made in December, decided by a large majority to reject it. The Associated Society had meanwhile accepted it. The main feature of the award is that from February 1st all new entrants into railway service may be started at the basic rate, but without the cost of living bonus now paid. The men oppose that course because they assert that it lowers the standing of the service. On Monday the men's leaders met the railway general managers to ask them to abandon the award, but the companies declined to do so. That was reported to the delegates' meeting, which thereupon discussed the question as to a strike. Eventually, by 41 votes to 36, it was agreed to accept the award.

Notes and Memoranda.

THE opening of the new Murray Bridge, Australia, recalls the fact that the material for the first bridge at that place was imported as early as 1868, but the erection was not started until 1873. The old bridge is 1983ft. long, and was designed for road traffic only, but since 1886 it has also had to carry the railway. It is to be retained for road traffic.

IT is reported in the *Engineering News-Record* that some roads in Idaho were recently cleared of scrap iron, presumably dropped off motor vehicles, by means of a large electromagnet hung beneath a 5-ton wagon 4in. above the road surface. In one case 150 lb. of ironwork was collected from 5 miles of road, and in another case 603 lb. was extracted from the road surface, but the distance is not mentioned. It is said that much of the material was invisible to the naked eye.

PHOTOGRAPHS of the solar eclipse taken by the American Swarthmore Expedition with a view to obtaining further information on the Einstein theory failed. The photographs of the corona, however, were splendid. The Einstein photographs taken by the German, the Dutch, and the other American Expedition were most successful. It was decided not to demolish the apparatus connected with the investigations into the Einstein theory, in order that nocturnal photographs might be taken in two months' time.

REFERRING to the Board of Trade returns, the British Engineers' Association points out that some of the most satisfactory figures are those relating to the exports of machinery, motor cars, locomotives and electrical apparatus. The total of exports of machinery for December—47,744 tons—is not only the highest monthly total recorded last year, but is higher than that of any month during the past three years. The total exports of machinery for the year 1925 amounted to 515,896 tons—the highest figure for any year since 1913.

AN account is given in a paper by V. H. Legg and R. V. Wheeler, just issued by the Safety in Mines Research Board, of plant cuticles in coal. The cuticle in coal (of which this paper makes a preliminary study) is the outer protective covering of leaves and stems common to all living plants. It is particularly resistant to decay and survived almost unchanged amongst the decaying vegetation that ultimately formed coal; it is now found preserved in many bituminous coals and gives characteristic chemical properties to them.

A SELF-CONTAINED X-ray apparatus mounted on a fast motor car so that it may be rushed to a case in any part of the country at a moment's notice, is proving of value to doctors who wish to avoid moving their patients. From the time of arrival at the patient's house or at the nursing home, the apparatus can be put into action in ten minutes. There is a dark room on the car, and the film can be developed and the radiograph handed to the doctor in twenty minutes. The apparatus was designed by Mr. J. C. Wilson, formerly a pilot in the Royal Flying Corps.

SPEAKING at a conference on Education and Industry at Chicago University recently, Mr. Charles M. Schwab said that altogether too many men had to do routine jobs unrelieved by variety or change of scene. He believed that a man got his greatest joy out of work, and he had no patience with those who thought that men were going to be happier when they had to work only four or five hours a day. Every man got his greatest joy out of real achievement. It was necessary to work out a plan, however, whereby men, even in the subordinate ranks of life, might obtain that sense of achievement out of performing routine tasks.

As a part of its experimental blast-furnace studies, the American Bureau of Mines has produced about 136 tons of an alloy containing from 5 to 15 per cent. manganese and averaging about 0·6 per cent. phosphorus. It is the scope of this investigation to determine whether metallurgical treatment can be developed whereby it will be possible to separate the iron, manganese and phosphorus. Preliminary tests indicate that the iron can be reclaimed in the form of steel containing negligible amounts of sulphur. The manganese will be converted into an oxide and recovered in a slag which can be used as an artificial ore in the production of ferro-manganese. This last phase of the work is the primary purpose of the investigation.

THE purpose of an investigation being conducted by the American Goverment at Tuscaloosa, Alabama, is to develop means of treating low-grade high-silica iron ores of the South, and particularly of the Birmingham district, whereby they may be rendered available for blast-furnace use. With the development of satisfactory methods of treatment will come a large increase in the iron ore reserves. The purpose of the four studies is: (1) High-silica red ores, to remove part of the insolubles of the ore with a minimum loss of iron, thereby increasing the iron content in the product going to the blast-furnace; (2) high-silica, specular gray hematite, similar to that for the high-silica red ores; (3) low-grade brown ores, to develop a coarse treatment for removal of clay, gravel, and chert; (4) blast-furnace flue dust, to remove enough carbon and insoluble material from the flue dust to make a concentrate high enough in iron for blast-furnace use.

A DESCRIPTION of the modification of the Orsat apparatus as used for the analysis of gases is given in Technical Paper 320, just issued by the American Bureau of Mines, Department of Commerce. This paper describes the apparatus used in the Bureau of Mines gas laboratory at Pittsburgh, Pa., for the complete and partial analysis of gases. A complete analysis—including carbon dioxide, illuminants, oxygen, carbon monoxide, hydrogen, methane, and ethane—can be made without connecting or disconnecting any parts. Since all other constituents are removed before the paraffin hydrocarbons are burned, larger amounts of the paraffins may often be taken for combustion with oxygen, and more accurate determinations of methane and ethane can thus be obtained. The same argument holds true for hydrogen and carbon monoxide, which are determined by fractional combustion with copper oxide at 300 deg. Cent. Either mercury or water may be used as the confining liquid in the burette, depending on the accuracy desired.

Miscellanea.

THE Spanish Government has decided to set up a National Fuel Council.

A NEW sheet and galvanising works, with six mills, is to be constructed by the Llanelly Steel Company.

ANOTHER blast-furnace and a battery of fifty-four coke ovens are being started up by the Wigan Coal and Iron Company.

AN order for a bell weighing 15 tons has just been received from America by Gillett and Johnston, of Croydon. It will be the second largest ever cast in this country.

BY a process of diverting the Turanganui River, the area of Gisborne Harbour, New Zealand, is being considerably extended. A depth of 30ft. at low water is to be provided.

THE Tipton coal seam has been reached by the Staveley Company at the Markham Colliery, Derbyshire, while the deep soft coal has been struck in the Pebley Pit of the Barlborough Colliery.

THE Town Council of Barton, Ontario, proposes to extend the local water supply system by the erection of a 250,000-gallon elevated steel tank, and the laying of 15 miles of pipe, ranging from 6in. to 12in. in diameter. The total cost is put at 323,000 dollars.

THE sum of £81,000 has been appropriated by the Tasmanian House of Assembly for the purpose of extending the hydro-electric enterprise in the State. The expenditure is to be allotted for power and general purposes in towns in the north and north-west, and for country districts branch and Hobart district branch work.

IN consequence of the growth of colliery enterprise in Nottinghamshire the Retford Town Council has decided to embark upon an electricity scheme, supplementary to the gas undertaking, which is owned by the Corporation. The current will be generated in connection with the gas undertaking, and the estimated expenditure is £27,000.

THE scheme for the conservation of the waters of the Lachlan River, New South Wales, includes the erection of a dam at Wyangala, near Cowra, at a cost of £1,352,000; an increase of the storage at Lake Cudgellico, at a cost of £75,000; and the construction of a continuous series of low weirs between Goolagong and Booligal, at a cost of £137,500; or a total of £1,564,500.

AS much as 11 milligrammes of radium bromide have been extracted from 2½ tons of crude ore taken from the United Mount Painter Mines, Australia. A new concentrating plant, with an ultimate capacity of 400 tons of concentrates a month, is being erected. Titanium, vanadium, uranium, and other rare earths, in addition to radium itself, will be produced.

THE Board of Trade has decided to suspend the examinations of engineers during the month of August, and the examinations will in future be discontinued as from the first Monday in August in each year, and will be resumed on the first Monday in September. During the present year the examinations will be suspended from Monday, August 2nd, to Saturday, September 4th, both dates inclusive.

THE Salford Electricity Committee has recommended to the Corporation that application be made for sanction to a loan of £132,333, to cover the cost of mains and services in Salford and Prestwich, the erection and equipment of sub-stations, the provision of plant at Frederick-road Power Station, &c. The contract rates for the supply of electricity for motive power in the Urban District of Prestwich have been fixed at 5 per cent. above the contract rates in force in Salford.

THE next stage of the development of the Auckland, New Zealand, water supply system will, according to the *Commonwealth Engineer*, be the construction of the impounding dam in the Upper Huia Valley, where it is estimated that over 500,000,000 gallons of water will be stored. This supply will be tapped by an extension of the new 33in. main, and when all supplies are being drawn upon the daily delivery capacity to the city will be 19,000,000 gallons. The present arrangements provide for the completion of the Huia dam and pipe line by 1928.

THE top hard seam was, according to the *Iron and Coal Trades' Review*, reached last week at the New Blidworth Colliery, 5 miles from Mansfield. At Rufford near by the Barnsley bed was reached 167 yards nearer the surface, the depth at Blidworth being 721 yards. It is the No. 2 shaft that has reached coal first, but as the No. 1 shaft is 677 yards deep it is expected that within two or three weeks coal will be touched in that shaft. The High Hazel seam through which, of course, the sinkers have passed to get to the main seam is of quite good thickness, being 3ft. 5½in. thick.

THE local correspondent of the Federation of British Industries reports that there is waiting in Barranquilla, Colombia, for transportation to the interior, between 35,000 and 40,000 tons of cargo, while the total capacity of the combined fleets of the Magdalena River, including barges, is only 17,435 tons. From this figure must be deducted boats which are laid up for repairs—about 20 per cent.—leaving a total of 13,948 tons, so it will be seen that there is sufficient cargo to occupy those boats employed for the next three months without taking into consideration new cargo coming in.

A NEW system of signalling, that may later have important results in enabling the police in London and other towns to check the operations of motor bandits, is being tried in the provinces. At some twenty chosen sites in the borough of Halifax telephone boxes have been placed and in an elevated position near them are fixed coloured lights. By them the officer on duty at the police station can call the attention of a constable on the beat in the neighbourhood who will at once go to the telephone box for instructions. When thieves are trying to escape by motor car, this device should enable constables in the outlying districts towards which the runaways are heading to be instantly apprised of their approach. A similar type of apparatus has been adopted in Southend-on-Sea borough in connection with a new fire alarm installation which has been installed.

THE QUEEN MARY RESERVOIR CONDUIT

MR. HENRY E. STILGOE, M. INST. C.E., LONDON, ENGINEER

(*For description see page* 131)

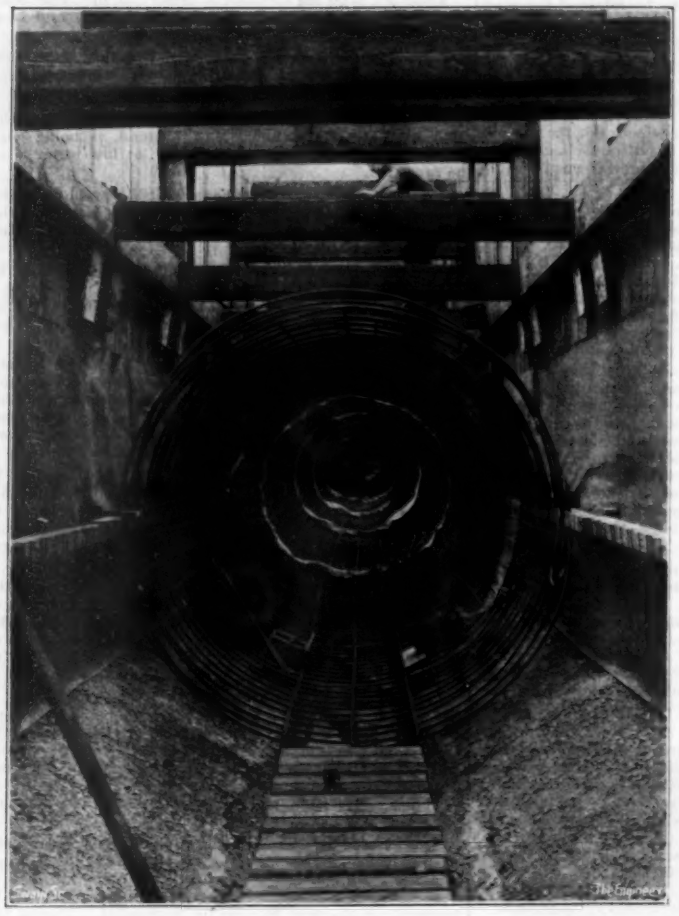


FIG. 1—SUCCESSIVE LENGTHS OF REINFORCEMENT AND LEAD FOR JOINTS

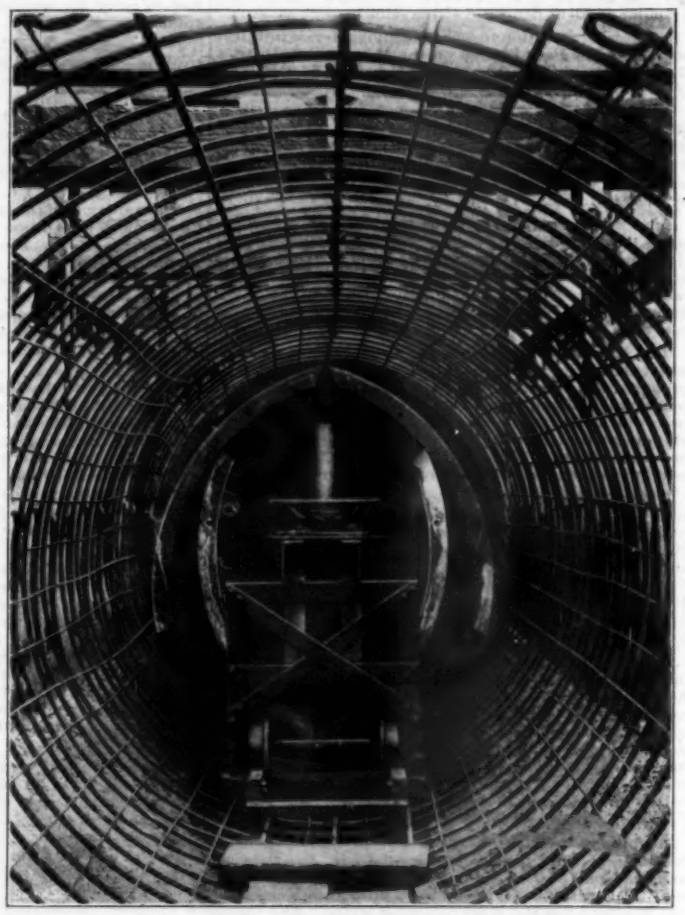


FIG. 2—REINFORCEMENT AND COLLAPSIBLE "BLAWFORM" CENTERING

FIG. 3—FLANGE OF 48in. BRANCH AND "BLAWFORM" CENTERING EXPANDED

FIG. 4—FLANGE OF 48in. BRANCH AND WOOD CENTERING

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE JANUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

JANUARY 29, 1926.

Engineering in America and Great Britain.

IT is never safe to assume that what is best in one country will be best in another. No two nations are alike. Their geographical position on the globe, the different climates they must enjoy or endure, the topography of the lands they inhabit, the long history of the races from which they are sprung, all build up characteristics which differentiate the peoples of the world, and give them that temperament which is generally called the genius of the people. Moreover, every nation is the plaything of traditions and the victim of its antecedents. It cannot change at will from one order of life to another, it cannot overcome the inertia of masses which have been accustomed to move for centuries in certain paths, nor can it brush aside the forces of vested interests. Observers may go from one country to another, and admiring the merits of one desire to see them engrafted upon another, but their desire will remain ungratified. The forces that brought about the character and practices of the first are different from those which moulded the second. We may say without great hesitation that if the same influences were at work throughout the world, and had always been at work, then all the peoples on the globe would have the same racial characteristics, and it would be easy for Great Britain or France or Russia to do just what Germany or America, or China, Japan of Czecho-Slovakia did. But the world is not built that way. There are national differences, which, if they can ever be overcome, can only be brought to similarity by intercourse extending over many centuries and by the continuous pressure of forces greater than those which moulded the race into its existing form.

These general observations are prompted by the reading of a pamphlet by Mr. Bertram Austin and Mr. W. Francis Lloyd, which has been recently privately circulated and has received a good deal of public attention. The authors are two young men who resolved to make, at their own expense, a tour of inspection of the United States. They were impressed with what they saw, contrasted it with what they knew of their own country, and were so profoundly convinced of the superiority of the American methods that they wrote down their critical reflections. "After a careful examination of the general conditions obtaining in the country, we have come to the conclusion," they say, "that the present prosperity can be traced to the adoption of, *and strict adherence to*, a few cardinal principles in the *management* of industrial enterprises." Those principles, they add, are due to Mr. Henry Ford. They are nine in number, and might be briefly described as the fundamental principles of *mass* production. The first is an expression of the doctrine of "small profits and quick returns"; the second asserts that there is no limit to productive capacity *per capita* if the proper appliances are available; the third tells us that "rapidity of turnover makes for smaller capital requirements," and will not be accepted without qualification by those who have had to face the initial expense of mass production methods; the fourth advocates the extension of payment by results, and expresses the common truth that high wages are not uneconomical, if the cost per piece is low; the fifth touches upon the importance of welfare; the sixth calls for a free exchange of ideas between competing firms; the seventh is devoted to promotion by merit; the eighth to the value of research and experimental work; and the last to the elimination of waste. There is, we imagine, not a single engineer in this country who has given attention to the economics of industry to whom these principles are not familiar. But Messrs. Austin and Lloyd will no doubt say that whilst we admit the correctness of these principles we do not practise all of them. That is true in part. But we might ask them if all the engineering firms in America practise them either? The fact is, as we have pointed out, that the principles are applicable in the main only to industries which are suitable for mass production and are not applicable as a whole to other industries. Small profits and quick returns is a fine motto for the builder of sewing machines and bicycles—and is regularly employed for such things in this country as much as in America—but it cannot be applied to the building of ships, the making of locomotives, the construction of large machine tools, and so on. Given an industry that permits of the adoption of mass production methods, then high rates of pay can be paid because means are at hand for reducing, by mechanical means, the cost per piece. But when things have to be made by the unit instead of manufactured by the million, the conditions change completely. The authors found in America that the inducement of high piecework wages was sufficient to produce very rapid output, and they have, we gather, assumed that the same inducement would have the same effect here. In that, we believe, they are mistaken. It may be possible here and there for a firm to defy the control of the trades unions, but it must be accepted as a common experience that piecework is not popular in British engineering works. The authors will say that the dislike to it is due to the practice of cutting the rates. We admit that that is always advanced as one of the reasons, but we are far from certain that it is the most influential. The lure of money is not so effective with British mechanics as it is with that heterogeneous class which follows the same callings in America. The question as to what wages men should be allowed to earn in an extremely complex one. It cannot be discussed briefly, but this at least may be said that, however much the cost per piece may be lowered by quick output for high wages, it would be still less with quick output and lower wages. There is surely an economic relationship between the amount of the wages and the selling cost, and we find it difficult to subscribe to the opinion of the authors that wages may be allowed to ascend to any level, though we agree that, as they say, "It is to the advantage of the community that the policy of industrial management should be directed towards raising wages and reducing prices." Of the four remaining cardinal principles laid down by the authors it is unnecessary to say much. The principles of welfare are as well understood in this country as in America. The free exchange of ideas has always been inculcated, but we think Messrs. Austin and Lloyd were a little misled if they came away with the impression that it prevails generally to a greater extent there than here. We have not found American manufacturers any more anxious to give away essential facts than their British cousins. As far as mechanical engineering is concerned, the days of the trade secret have gone or are going in both countries.

It is always of service when fresh minds are turned upon an old investigation, and although Messrs. Austin and Lloyd may have brought back from America no new truths, we are grateful to them for having expressed the old truths with the energy and assurance of young men. They have

entitled their report "American Prosperity," and we are quite willing to accept the principles they have enunciated as amongst the causes that have led to that prosperity. Where they are likely to have fallen into an error is in assuming, which they seem to do, that what can be done in America can be done here, and that it would have the same effect. Many American firms have come to England full of American ideas. As we know, they have only succeeded very partially in engrafting them upon British practice. Yet since they have stopped in our midst we may assume that they have found the British way not so hopelessly bad, after all. The most serious mistake made by the authors is in taking it for granted that the British workman and the American workman are alike, and that what will appeal to one will appeal to the other. The British workman is one nation, the American workman is a conglomeration of nations. The American units are out more for themselves than they are in Great Britain, where the trades unions have succeeded in establishing a cohesion and in many instances a true brotherhood which submerges the individual in the mass. As to the merits of that result there may be differences of opinion, but it must be accepted as a living fact which no economic desideratum can overthrow. Our authors have written at a moment when Great Britain is under an industrial cloud, and America in the sunshine. We hope that before many months have passed they will be able to find that the principles which guide the engineering industries of this country are not hopelessly defective, and that under them we can hold an even place with the United States of America.

Agricultural Engineering.

THE manufacture of mechanical appliances for agriculture is essentially of British and American origin, and makers in this country and in the United States continued to have a practical monopoly of the world's markets down to the outbreak of the war, their only competitors being certain German firms which were making rapid progress in the industry. In America the demand for agricultural machinery is so enormous that manufacturers find it worth while to produce a surplus for foreign distribution owing to a well-known economic principle. But in this country, which is not primarily agricultural, makers have to look to foreign markets for the greater part of their business. Any failure of the foreign demand is therefore a serious matter for the British agricultural engineering industry. Unfortunately, the situation of British makers has been going from bad to worse since the financial upheaval on the Continent. The quality of their machines has always set a standard to the world, and so long as the depreciation of foreign currencies left only a small margin of difference in values the farmer abroad was quite prepared to pay rather more for implements and machines which he had always used and in which he had perfect confidence. During the past three years the margin, especially in France, increased to such an extent that agriculturists refused to buy, in the belief that prices would come down, and then declared that it was impossible to purchase British goods at all. With the franc fallen to its present abysmal depths there is practically no business to be done either in British or American machines at prices adjusted to the exchange rate. One of the biggest American corporations started to manufacture harvesting machinery in France when the franc began its downfall, and a Canadian company is now contemplating similar action. If the business is to be retained or regained it can only be done, for the present at any rate, by adapting business methods to new conditions. The business is well worth the efforts being made by some firms to keep their hold on the European trade. Every country is endeavouring to produce more crops, and agriculture is regarded as the leading industry of the world, because it is the only one that can keep down the cost of living and prevent an economic disaster. So far as France is concerned the production has not grown to the extent anticipated, owing mainly to the dearth of labour. It can only be provided for by the more general employment of machinery, and the use of mechanical appliances on the farm is now far greater than it ever was before. We can see, indeed, the beginning of a vast transformation of the agricultural industry. This transformation is being facilitated by a remarkable development of agricultural engineering on the Continent. After the Armistice a large proportion of the war factories embarked upon the manufacture of farm machinery. In Germany some of the leading firms, like Krupps, are turning out immense quantities of implements and machines, and the interests of many small firms are protected by powerful combinations. In Czecho-Slovakia and in Poland great progress has been made in productive facilities, while probably the most striking headway has been made in France, where a vast industry has grown up during the past few years under the *ægis* of an influential organisation known as the Chambre Syndicale des Constructeurs de Machines Agricoles. If the European output is enormous it would cause no alarm to British makers if the conditions under which business is done were equally favourable to them. The requirements are still greater than the productive capacity, and British makers have no reason to despair over what may after all prove to be a temporary loss of trade.

The importance of France as a market for agricultural machinery was observable in the Salon de la Machine Agricole, which has just been held in the Parc des Expositions in Paris, and was certainly the largest and most imposing display ever made of every kind of mechanical appliances required for farm operations. It also showed the commanding position which has been acquired by the French agricultural engineering industry in its own market. This is due solely to the monetary depreciation, which has enabled French makers to develop a business on the strength of being able to sell at far below the prices of imported implements and machines. They are not protected by import duties to the extent that they feel justified in claiming, for it is regarded as an essential factor in agricultural prosperity that machinery prices should be as low as possible, and there has always been a tendency to favour the importation of machinery as a check against any inflation of prices on the home market. Some time ago farmers asked for the preferential treatment of foreign machinery on the ground that many of the French machines were unsatisfactory on account of their undue lightness and poor quality of material. In answer to this charge most French makers at the Paris Show drew particular attention to the resistance of the material used in the manufacture of their implements. Apart from the importance of the French exhibits there was a remarkable variety in the productions, and one of the noteworthy features was the progress of the heavy oil engine in its application to farm uses. So far as concerns practical design and consistent quality, British firms were again to the fore, and it was clear that under equal competitive conditions they would have no difficulty in holding their own. Prime movers are becoming more and more indispensable for farm work. The suction gas engine has so far failed to fulfil expectations, though official encouragement continues to be given to research in this direction. The cost of petrol places it beyond the pale of economic working; electricity for farm purposes has lost some of its erstwhile glamour, at least in regions removed from the main centres of supply, and the only satisfactory fuel at present is heavy oil in engines designed to use it to the best advantage. The agriculturist is becoming convinced that the immediate future lies in that fuel, for which reason he is taking a renewed interest in the tractor, and in anticipation of these requirements the number of tractors exhibited was particularly large. The revival of the tractor with heavy oil engine was indeed a special feature of the Salon de la Machine Agricole. It is clear that the field for agricultural machinery in France, as well as over most of the Continent, is rapidly expanding, for it has become indispensable to increase production with reduced costs, and the future of agricultural engineering therefore lies in turning out low-priced machines that will realise the greatest economies. So long as there is the possibility of the franc falling below its present level British makers have small hope of profiting from the growing trade on the Continent. While the present state of uncertainty continues the French manufacturer has an unquestionable advantage, but even he is beginning to see that the situation offers serious drawbacks, and he is already looking with uneasiness at the advancing costs and the diminishing supply of raw material. Much of the material consists of enormous stocks that accumulated years ago and are now fast disappearing. He has had to increase the prices of implements and machines, and everything points to the possibility of his having to raise them again, for to the higher cost of raw material further heavy charges are being added. The situation has now entered upon a phase when a sudden improvement in the franc may completely turn the tables and enable British firms to undersell the French in their own market. This is regarded in France as an alarming outlook, and the efforts to improve the franc are tempered with a desire to do nothing which may dislocate trade and industry. A rapid deflation is considered to be an evil scarcely less serious than an inflation, and in the interests of the country's industrial prosperity an attempt will be made to secure stabilisation, with a subsequent progressive improvement towards par. Even stabilisation will subsequently bring about an adjustment of prices which will enable British machinery firms to do business in France, and to what extent their hopes are justified will depend entirely upon the turn events take in the early future. Under favour of a depreciated currency the French have secured so great a lead in their own market that British makers can hardly hope to recover the whole of the business they did formerly, and they will, moreover, find themselves confronted with competition from Germany, which is already supplying huge quantities of agricultural machinery to the devastated regions on account of reparation; but the British productions have the advantage of enjoying an unequalled reputation for quality which will stand them in good stead when prices are adjusted in their favour.

Another point to be considered in the future development of continental trade is the importance attached to economy in agricultural practice. Agriculture is becoming an engineering industry, both technical and scientific, and the old rough-and-ready methods are giving way to a close study of economical production, in which the use of machinery is strictly calculated by the saving it will effect. A careful account is taken of capital cost, annual depreciation and efficiency. In an industry where competition will become increasingly keen those makers who can convince farmers that they are offering the means of saving money will the more readily sell their machines. Success in that direction depends frequently upon the adaptation of machinery to local conditions, but there is no reason why British manufacturers should not do still better than their foreign competitors in the way of enabling the continental farmer to secure greater economies. They have always taken the lead in technical developments. Standardisation has been made necessary by mass production, but there is no finality in mechanical achievements, and it is still possible for British makers to enhance the value of their agricultural machines by securing economies which will give them an advantage over their competitors. A period of industrial depression is usually more prolific in mechanical improvements than one in which makers are able to sell readily all that they can produce.

The Carnot Centenary.

THE name Carnot is in France associated essentially with organisation, patriotism, and education. The great scions of this family, Lazare Nicolas Marguerite (the father), the "Organiser of Victory" under the first Republic; Hippolyte (the brother), Minister of Education (Instruction Publique) under the Provisional Government of 1848; and Marie François Sadi, the son of Hippolyte, President of the Republic from 1887 to 1894, loom so large in French history, political and educational, that they eclipse the name of the brilliant student of science, Nicolas Léonard Sadi Carnot.

Moreover, all these members of the family were brilliant mathematicians at a period when France excelled in science, and they were educated as engineers, either military or civil. It is not therefore so remarkable that the small book, published by N. L. S. Carnot, when twenty-eight years old, consisting of only 100 pages, entitled "Réflexions sur la Puissance Motrice du Feu," should have passed unnoticed, and it is still easier to understand this neglect when we recall that eight years later he died of cholera, and that many of the papers he left were destroyed in consequence of this epidemic.

The work is remarkable for the two great principles set forth by the author: the cycle represented by two isothermal and two adiabatic curves, and the reversibility of the perfect heat engine.

The work did not, however, wholly escape attention, for Clapeyron, in a paper written for the Ecole Polytechnique two years after the death of Carnot, suggested a graphical illustration that would facilitate the understanding of the principles enunciated by Carnot, and submitted them in the form in which they are so well known to-day. Once more the subject sank almost into oblivion till 1845, when William Thomson, who was then studying in Paris, had his attention drawn to the work of Clapeyron, and was led by it to search for that of Carnot. The great British physicist, later Lord Kelvin, hunted in vain for a copy till 1848, when he found one. It is further remarkable, and evidences the limited number of copies of the work, that Clausius stated twenty-two

years later, in 1870, that he had never been able to find a copy of Carnot's book.

A paper,* printed in the "Proceedings" of the Cambridge Philosophical Society for June 5th, 1848, and in the *Phil. Mag.* of October, 1848, was entitled by Thomson:—"On an absolute thermometric scale founded on Carnot's theory of the motive power of heat, and calculated from Regnault's observations." In it Sir William mentioned that he first saw a translation of Clapeyron's paper in the first volume of Taylor's "Scientific Memoirs."

A later paper† by Sir William, printed in the "Transactions" of the Edinburgh Royal Society, XVI., 1849, contains an appendix,‡ of which the opening paragraph is:—

"In p. 30, some conclusions drawn by Carnot from his general reasoning were noticed; according to which it appears, that if the value of μ for any temperature is known, certain information may be derived with reference to the saturated vapour of any liquid whatever, and, with reference to any gaseous mass, without the necessity of experimenting upon the specific medium considered. Nothing in the whole range of Natural Philosophy is more remarkable than the establishment of general laws by such a process of reasoning."

In celebration of the centenary on January 20th of the publication of Carnot's remarkable essay, to whose author so high a eulogy has been given by Britain's greatest physicist, a public meeting of the French Society of Civil Engineers was held. Throughout this meeting Monsieur Doumergue, the President of the French Republic, presided, supported by M. de Monzie, Minister of Public Works, M. Daniel Vincent, Minister of Commerce, M. Daladier, Minister of Education, M. Durafour, Minister of Labour, M. Laval, Under-Secretary of State, M. Baclé, the President of the Society, Lieut.-Colonel Sadi Carnot (representing the Carnot family), MM. Daniel Berthelot, Le Châtelier, Guillet, Koenigs and Rateau, members of the French Academy of Science, and very many of the leading men of science and engineering.

The speeches, of which we given abridgements below, contained well-considered and weighty appreciations of the work of Carnot, and with a greatness worthy of the occasion, brought out the effort of William Thomson to turn Carnot's work to account.

SPEECH BY M. BACLÉ, PRESIDENT OF THE SOCIETY OF CIVIL ENGINEERS OF FRANCE.

A CENTURY has passed since a young French scientist formulated two mechanical principles which marked the beginning of a new era, not only in the history of pure and applied science, but also in the evolution of human thought. In his "Reflexions sur la Puissance du Feu," Nicolas Leonard Sadi Carnot presented for the first time novel considerations which furnished the great fundamental principles of thermodynamics. He showed that from the point of view of its action in engines, the flow of steam might be compared to the flow of water whose energy is limited by its head. He showed, moreover, that the useful work obtained depended exclusively upon the initial and final temperatures, and that there was no need to take account of intermediate states.

Sadi Carnot was the son of the great Conventionnel, who was known, under the first Republic, as the Organiser of Victory. Hence he bore a name already illustrious in the national history of France, but he was only twenty-eight years of age when he published his immortal book, and he did not enjoy in the scientific world that personal authority which could ensure the adoption of views which were entirely new. Hence, when he died eight years later, he had not felt the supreme consolation of witnessing the preliminary signs of that success which his views were ultimately to attain.

That success did not appear until thirty years later when the great physicists of that epoch, with Sir William Thomson (Lord Kelvin) at their head, desired to establish the theory of the steam engine by creating a science of thermodynamics, and were led to place at the foundation of the new science the fundamental laws which Carnot had formulated. In these laws mechanical engineers found the necessary elements for the calculation of all kinds of heat engines, and we may therefore say that Carnot was the initiator of the marvellous industrial development which characterised the second half of the last century, and in which the development of the heat engine was the principal factor.

But it was not alone in their application to industrial engines that the principles of Carnot could be applied. They were also employed for the explanation of great natural phenomena, and thus showed that they expressed a general law of the physical world. A drop of water raised from the surface of the sea by the heat of the sun into the clouds, from which it falls again to the surface of a continent and descends once more to the ocean, describes a reversible cycle, just as do the molecules of oxygen or of carbon passing alternatively from the mineral world to organic life through a series of incessant combinations continually set up and broken down. Both obey the laws of Carnot, which, in fact, embrace all the modes of action by which internal energy is manifested in the universe. By such considerations, we can appreciate the fecundity of Carnot's work, and it is a duty which belongs particularly to our Society to commemorate the glorious memory of one of whom all engineers are disciples. It is for that reason that we have organised the present Centenary celebrations, which are honoured by the members of the illustrious family of Carnot. It has become indeed a national ceremony, for the civil and military authorities have combined with science and technology, and joined with us in making this patriotic reunion an expression of national feeling. We are proud and happy to welcome the representatives of the great colleges, of the great scientific societies, and especially the delegation from L'Academie de Science, which includes, in particular, the two eminent scientists who will speak with the authority which belongs to them of the importance of the principles of Carnot in the explanation of the great laws of Nature. In Monsieur D. Berthelot you will listen to one who has also formulated laws which have increased our knowledge of Nature, whilst Monsieur Henry le Chatelier will discuss the principles of Carnot in their relationship to chemical energy.

RESUMÉ OF AN ADDRESS BY M. D. BERTHELOT.

About a century ago there appeared in the Libraire Bachelier a small volume of 118 pages, which was modestly entitled "Réflexions sur la Puissance Motrice du Feu et sur la Machines Propres à Développer cette Puissance." It was written by Sadi Carnot, an old pupil of l'Ecole Polytechnique and was the only work he published. Eight years later, in 1832, Carnot fell a victim to the cholera epidemic, and all his papers were burned with the exception of a small book of manuscript notes—of inestimable scientific value—which, in 1878, fifty years later, was presented by his younger brother, Hippolyte Carnot, to l'Académie des Sciences, in the archives of which institution it is to be found to-day.

Carnot's book on the motive power of heat remained practically unknown until, in 1834, two years after his death, Clapeyron wrote in Vol. XIV. of the *Journal de l'Ecole Polytechnique* a remarkable memoir, in which he proposed a simplified graphical representation of Carnot's ideas, which to-day has found general use. It was in 1848 that William Thomson's attention was called to the work of Clapeyron and Carnot, and later Thomson brilliantly developed one of Carnot's principal ideas, namely, the scale of absolute temperatures. Some twenty years later still, Clausius, a worker in the same branch of science, declared that he had never seen Carnot's work, and had only heard of it through quotations from Clapeyron and Thomson.

It is the centenary of this little volume which we celebrate to-day. The original ideas and conception of Carnot have now found full recognition in the wider domains of the physical and the chemical sciences. The young doctor of twenty-eight was too far in advance of his contemporaries to be understood by them. A century has, however, rolled by, and has put things in their relative places, and to-day the immortality of the name of Sadi Carnot is assured by those few short pages, more than it could have been by many large volumes.

The theory of heat and prime movers was founded by Carnot on a basis which has not been shaken. His principal idea was entirely new, and was not to be found in the work of his contemporaries, although the general ideas of Rumford and Davy had something in common with his own. As Gabriel Lippman has written, his work marked the beginning of the modern science of physics. He applied to the heat engine new modes of reasoning which have since been accepted. The first of his principal ideas was that of the cycle of operations, and his name is particularly identified with that cycle, which is made up of two isothermics and two adiabatics. A second idea which he developed and applied to the perfect heat engine was the reversibility of the cycle. A consideration of the ideal reversible cycle enabled him to enunciate the important principle that the maximum mechanical power obtained from heat was independent of the fluid employed, and was determined alone by the difference between the upper and lower temperatures of the working fluid. In other words, the efficiency of a heat engine is a function of the temperatures at which heat is taken in and rejected—the boiler and the condenser. That function was left undetermined by Carnot, and it was independent of any theory as to the true nature of heat. The application of Carnot's cycle to gaseous working fluids was made possible as the knowledge of the laws which governed pressure, volume and temperature changes were known. And with the fixing of the absolute temperature the classical expression for efficiency—that efficiency is equal to the difference between the absolute upper and lower temperatures of the cycle divided by the absolute upper temperature—was formulated.

Before his death in 1832 he had arrived at the conclusion that there was an equivalence between mechanical work and heat. He had fixed the value of that equivalent at 370 kilogrammetres, which was very near that of Meyer given later in 1842, which was subsequently corrected to 425 kilogrammetres by the direct experiments of Joule.

It was given to Sadi Carnot to discover successively the two main laws of thermodynamics. His work was alike characterised by its originality, its soundness, and its fruitfulness. The application of Carnot's principle showed to the engineer that whereas the efficiency of a mechanical or an electrical machine could be as much as 90 to 95 per cent., that of the heat engine could not rise above 20 to 40 per cent., and in practice it often fell to a figure between 10 and 20 per cent. The arguments advanced by Carnot in his little book have to-day not lost their value, and it is well to remember that the latest practice of stage bleeding for feed-water heating, which is now carried out in the power stations of Europe and America, was discussed and recommended by Carnot more than a century ago. Equally important is the impetus which Carnot's work gave to the sciences of physics and of chemistry. The new ideas introduced by Carnot a century ago have lost none of their value or truth, and they may still be called upon to guide future investigators in the paths yet to be trod.

ADDRESS BY MONSIEUR HENRY LE CHATELIER.

In the course of an all too brief existence, the sole manifestation of Carnot's activity was the publication of his essay on "La Puissance Motrice du Feu."* It was inspired above all by a practical desire to increase the efficiency of the heat engine and to aid French industry in its competition with that of Great Britain. The moral sentiments which bring the memoir to an end contributed to mask its scientific importance. Carnot admitted that details of construction, simplicity of the parts, lubrication and proper maintenance of engines were often more important than thermodynamic efficiency, but he himself recognised the scientific importance of his work, and he indicated how his reasoning made it possible to establish certain relationships between the numerical coefficients of the diverse properties of matter, relationships of which the development constitutes to-day the science of thermodynamics.

One peculiarity of the memoir is the difficulty that there is in picking out its dominant idea. All the world admits to-day that Sadi Carnot discovered the second law or principle of thermodynamics, but in what does this second principle consist? No two scientists are agreed on its definition. It is frequently expressed as—"The ratio of the quantity of heat given by the boiler to that received by the condenser is equal to the ratio between the absolute temperatures of the two sources." But Sadi Carnot said nothing of the kind. He admitted the equality of the quantities of heat exchanged between the two sources, and knew nothing about the notion of absolute temperature. In fact, this theory of efficiency was established twenty-five years after the publication of his essay. In reality, Carnot formulated no new principle. All he did was to take two known facts, to unit them by a syllogism and to deduce very interesting consequences from the new theorem. By the employment of logic, Sadi Carnot raised a new science; he did not only discover an isolated theory. He is the true and only creator of Thermodynamics, or, more generally, of Energetics.

The two facts on which Carnot worked were, in the first place, the impossibility of perpetual movement, and, in the second, reversibility, or the possibility of transferring power from one perfect machine to another without loss of energy, and of doing so in either direction. He found the first fact in the general knowledge of the day, and the second had been expressed by Lazare Carnot, his father. A further peculiarity of the famous essay is its silence on the subject of the conservation of energy. Carnct had discovered it before Meyer, as is shown by notes found amongst his papers. Why, then, did he keep the discovery secret? He could not ignore its importance, and he had no doubt about its accuracy. There can be little doubt that he was guided by the sentiments of moderation and of prudence which his father inculcated, and that he judged it imprudent to ventilate his ideas upon the nature of heat if he desired to avoid a struggle with his contemporaries and to safeguard his own tranquility.

When the Carnot principle had been estabished by Clapeyron, Kelvin, Rankine, Helmholtz, and Clausius, it was deflected into an entirely new direction by the discovery of chemical reversibility by St. Claire Deville, and the American astronomer, J. W. Gibbs, laid down all the laws of the mechanics of chemistry, but with such a luxury of mathematical formula that chemists were for a long time deterred from pursuing the inquiry. A few of these laws—half a dozen at most—have a capital importance. They have exercised a preponderant influence on the progress of science and have provoked the birth of great industries. These laws are, first, the Law of Factors. The principle that it is impossible to create power shows without any calculation that the only values on which the equilibrium of a system depends are those which can only be obtained at the expense of work. Catalysers, for example, can in no case be factors of equilibrium. Their only *rôle* is to accelerate

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* The Mathematical and Physical Papers of Sir William Thomson, Vol. I., p. 100, No. XXXIX.

† *Loc. cit.*, p. 113, No. XLI.

‡ *Loc. cit.*, p. 143.

* For an English version our readers may be referred to Thurston's translation published under the title "Reflections on the Motive Power of Heat," by Macmillan and Co., in 1890.—ED. THE E.

the speed of chemical reaction, just as oil facilitates the movement of the organs of machines and engines without modifying their final state of equilibrium. Secondly, the Phase Law, propounded by J. W. Gibbs, which fixes the maximum number of variations which can occur in a system in equilibrium without destroying that equilibrium. Thirdly, the Law of Equivalence. The independence of motive force of the course covered in the accomplishment of a reaction leads to the law of equivalence of chemical systems. Fourthly, the Law of Stability, which states that any variation of a factor of equilibrium causes a displacement of the system in such direction that the quantity of energy liberated by the reaction tends to compensate, at least partially, the initial variation of the factor. A rise of temperature displaces the reaction in the direction corresponding to an absorption of heat. Fifthly, Law of Isoequilibrium, which establishes a relationship between the variations of pressure, of temperature, and of electromotive force to which one can subject a chemical system in equilibrium without destroying that equilibrium. Sixthly, the Law of Solubility, which gives at once an explanation of the form of the curves of the solubility of salts and permits us to calculate exactly the tangent to those curves at the points of transformation.

These laws are absolutely rigorous, and it is surprising that chemists had not reached them by experiment, and did not even suspect their existence.

In commemorating to-day the centenary of a great French scientist, we are justified in recalling the great part taken by France in the development of the sciences. In recent times our country has been the initiator of all civilisation, as Greece was in the days of antiquity. In these two countries, literature, art, philosophy and science move forward side by side. The creators of experimental science—Pascal, Descartes, Lavoisier, Ampère, Carnot, Berthelot, Pasteur—were great authors and philosophers as well as scientists. Humanity owes to Greece the invention of the syllogism. The sons of France have preserved its glorious tradition. By simplicity, clearness and precision of their ideas, they have imposed their doctrines upon the whole world. No one has shown so brilliantly as Sadi Carnot this power of human thought. He transformed by pure reasoning common facts at the disposition of all men into the most perfect of the sciences. To honour his memory, let us ever preserve to France her civilising mission, and let us maintain the traditions of high intellectual culture which have made her scientists. Let us not sacrifice our old classic humanities to a documentation pseudo-utilitarian, nor put reason below memory. Thought alone is creative.

Safe Loads and Endurance of Steels under Repeated Bending Stresses.

THE nomenclature of the various points in a stress-strain diagram admittedly leaves much to be desired, both in regard to accuracy and uniformity. As a measure of the behaviour of an "elastic" metal under simple tensile stresses, what is usually known in this country as the elastic limit, affords, to some extent, a satisfactory criterion of the relative behaviour of a range of materials tested under similar conditions of time and loading, on test pieces having geometrically similar shapes, when the predominating variable is the composition. Meanwhile, the "elastic limit" has, of late, come in for a good deal of not wholly undeserved criticism, and is used in a number of different and not always reconcilable senses.

These reflections are inspired by an interesting memoir on "Safe Loads and the Endurance of Steels Under Repeated Bending Stresses," by Drs. V. Prever and E. Balma, of the Research Department of the Fiat Works, Turin, and published in *Ingegneria* some months ago. The authors point out that the various manuals and treatises which purport to give tables relating to safe loads for material subjected to various kinds of stresses, refer these almost wholly and solely to data derived from tensile tests:—(*a*) Under permanent and constant load; (*b*) in constant time, the stresses varying regularly from zero to a maximum, and then decreasing again regularly to zero; and (*c*) in constant time, with stresses varying from a maximum to a minimum, but acting alternatingly, in opposite directions. The "factor of safety" is a whole-number multiplier—4, 6, 12, &c., to be applied as deemed expedient.

After quoting the classical results of Wöhler and Bauschinger, the authors come to the issue: "Is the elastic limit a satisfactory criterion? What is it and what does it mean?" They thereupon schedule in parallel columns some ten definitions of the terms elastic limit, proportional limit, and fatigue limit, culled from English, French, Belgian, Italian, and German sources and from the most eminent authorities. Most of these definitions are of a conflicting character; many of them overlap, and, according to Drs. Prever and Balma, they are all of more or less doubtful value and validity. In order, therefore, to ascertain what value, if any, attaches to elastic limit determinations from the point of view of "safety" in engineering construction, particularly in automobile and aeronautical engineering, the authors have made a number of alternating bending stress tests on a series of forty-two steels comprising a wide range of compositions and including several nickel and nickel-chromium-tungsten steels with varying carbon contents. Many of the tests were carried out on an Amsler machine, the construction of which the authors criticise. The tests were made both on notched and unnotched bars.

The broad conclusions reached by the authors are that the safe loads and the relative coefficients now in use represent nothing of any mathematical certainty, and are of no more than a conventional character. The tendency prevalent in practice, of assuming the safe load to be always lower when the velocity of the part to which it is to be applied is higher—and therefore when the *total number of reversals of stress* which the part is called upon to sustain is higher—finds its justification, however, in the results of the authors' experiments, which prove that the practical limits of fatigue are lower in proportion as the *number of minimum loadings increases*.

In using the Amsler—1916 model—with quadrupal hammers, difficulties are encountered in regulating the fall of the hammer, in properly securing the test piece, in the impossibility of stressing the piece at low speed impacts—such as are experienced in actual working—and in regard to the slowness of the test—which renders the operation exceedingly tedious.

It is, in the authors' opinion, extremely irrational to carry out repeated stress tests of a much greater intensity than those which a part may, in practice, be called upon to sustain. This is, indeed, to subject the part to stresses which it is carefully sought by the designer and engineer to avoid in practice, and they suggest that no useful purpose can be served by putting the material to such extreme stress. In regard, however, to the influence of the notch, such a mode of testing may supply some sort of information and the specially injurious effect of the notch on the fatigue strength of certain steels, on repeated stresses, is well borne out by the results of the authors' tabulated experiments. The notched bar test does not bear much, if any, true relation to the results of the tests on unnotched bars. A nickel chromium tungsten steel with medium carbon, hardened and annealed, behaved badly under notched bar tests, but it showed very little superiority under unnotched bar tests.

The number x, of the applications of stress which a material can sustain may be expressed as $y = a\,x^n$, a and n being constants which can be ascertained in respect of different steels, but in regard to the nature of which it is not at present possible to hazard even a conjecture.

The curve, stress-number of alternations, which a metal can support, is much the same for different steels. Resistance to high stresses affords no necessary indication as to the superiority of a steel, nor as to how it will behave at moderate or even low stresses. This exposes the fallacy of carrying out tests at too high stresses on the plea of accelerating the test.

What is probably the most important conclusion is that these authors consider that it has not as yet been demonstrated that steels possess any definite fatigue limit, below which a stress can be indefinitely repeated without occasioning fracture. This, however, appears to ignore important recent works both in England and America. The practical fatigue limit is regarded as a much more important consideration than any theoretical "absolute" limit of this nature. This is the minimum number of alternations of stress a steel can withstand, and this minimum must be high enough to insure the material lasting properly. There is more than one fatigue limit: there are, in practice, as many as there are kinds of stress a material may have to undergo. This depends on the purpose for which it is required. The size and shape of a part are most influential in concentrating, to a dangerous degree, localised stresses which, if more diffused, would not be dangerous.

The surface of fracture affords a most valuable indication of the nature and intensity of the stresses a metal may have had to endure. Such a fracture is often typical, but a fair amount of experience is necessary in order to interpret the appearances correctly. A number of photographs of such fractures are given by way of showing how the effect of the predominating stress betrays itself by characteristic markings, or a streak which may show whether the material has broken suddenly or whether it has failed gradually.

The practical results of the authors' experiments establish very clearly that medium stresses repeated with great frequency, and for long continued periods, may prove just as dangerous as much higher stresses of lower frequency or shorter duration, or both, and that the behaviour of materials may very often be ascertained with much greater accuracy and certainty when bending alternating tests are substituted for the alternating tensional tests now often applied.

The photographs of the fractures which accompany the paper and to which reference has been made when compared with the tabulated results of the tests and the composition of the steels to which they relate, constitute a valuable record of much good and useful work.

ALTHOUGH the new port at Gdynia, Poland, has not been finished yet, it has been decided to start using it for coal exporting.

Institution of Electrical Engineers.

THE semi-jubilee dinner of the North-Western Centre of the Institution of Electrical Engineers was held on Tuesday, 26th inst., at the Midland Hotel, Manchester, when there was a record attendance of over 250 members and guests. The chairman of the Centre, Mr. A. G. Ellis, presided, and he was supported by Mr. R. A. Chattock (President of the Institution), Sir Holberry Mensforth, K.C.B., Sir Benjamin Longbottom, Lieut.-Colonel Sir Joseph Nall, Mr. Austin Hopkinson, Major-General Sir Philip Nash, K.C.M.G., Dr. F. H. Parshall, Alderman Walker, Mr. S. L. Pearce, Captain Hilton, and Mr. H. C. Lamb. The toast of "The City and Trade of Manchester" was proposed by Sir Holberry Mensforth, and responded to by the Mayor of Salford. Lieut.-Colonel Sir Joseph Nall proposed the toast of "The Institution of Electrical Engineers," to which Mr. R. A. Chattock replied. Mr. Chattock took the opportunity of commending to the members the necessity to support the Wireless sections of the branches, and said there was no necessity for a separate institution for that branch of engineering. He also advocated the support of the electrical industries for the forthcoming British Industries Fair, which, he said, was being looked after by the Birmingham section of the Institution.

Referring to the Government's electrical scheme, Mr. Chattock said that, generally, it met with approval, although there were some details which were, some thought, objectionable. He wished the scheme every success, subject to reservations; adding that his views upon the matter of standardisation were known. They wished to be satisfied before agreeing, that the dislocation of their business was justified. He hoped that the Government was not going blindfold into an expenditure which could not be justified.

The toast of "Our Guests" was submitted by the Chairman, and was replied to by Sir Philip Nash and Mr. S. L. Pearce. In his reply, Mr. Pearce dealt with one or two of the criticisms that had been launched at the Government scheme. He said that, so far as he could express the view of the Electricity Commissioners—and that would be his advice to the Ministry—there was no idea of abolishing the regional committees, which he hoped would continue to fill a most useful *rôle* under the new scheme. He even went further, and thought it would be wise to arrange for some degree of delegation to the regional authorities, so that they might act as agents for the Board. He maintained that the consumption of current per head of population could be greatly increased by the use both of cheaper energy and cheaper plant, and the Government proposals should secure the second of those advantages no less than the first. The estimates that had been framed and approved by Lord Weir's Committee visualised a time when the consumption per head of population might be expected to reach 500 units, and the units sold would be something of the order of 21,000,000,000 per annum. It was to meet such conditions that the technical scheme had been framed. He thought that it must be agreed that manifest economies could be secured by a selection of the most efficient stations, and by so using them as to secure the maximum economies in operation. Replying to the criticisms that, great as these economies might be, they would be offset by the costs of inter-transmitting lines, of standardisation, and of administrative expenses, Mr. Pearce said that they could be sure that the advisers to the Weir Committee and the Ministry had gone most carefully into that matter. The soundness of the scheme in that respect had been tested by a mass of calculations and an enormous amount of work, and those figures had been confirmed by eminent opinion, endorsed by the Weir Committee and approved by the Government. Finally, Mr. Pearce said that the scheme was not one that sought to set up any fettering Government control, but rather to work through the existing agencies and to assist them as far as possible. The Commissioners had no axe to grind and no sectional interests to serve. Their one interest was to improve and assist the development of the electrical supply industry of the country.

THE COMMERCIAL ASPECT OF FOUNDRY WORK.

IN the course of a lecture to the Junior Institution of Engineers on January 15th, on "The Commercial Aspect of Foundry Work," Mr. J. Wolstenholme said that in his experience no other section of the engineering trade had been so neglected as the foundry. In pre-war days it was probable that at least 75 per cent. of the foundries of this country were hopelessly out of date. Because of its very nature, it would be always more or less a "dirty trade," and that seemed to have been made an excuse for neglecting it as much as possible. During the war and after an effort had been made by many firms to give that attention to the foundry which had been previously bestowed on the machine shops. Conditions were therefore much better, but there was still much room for improvement. One of the greatest difficulties in the way of progress was the impossibility of getting a good supply of trained or educated men to take some interest in foundry working.

As the commercial side of foundry work was concerned with the economical production of castings, it was necessary to have some method of arriving at the cost of castings, both in the estimating stage and, finally, after the castings were produced. Mr. Wolstenholme enunciated methods of ascertaining the exact cost of each process in the foundry and gave actual figures from practice by way of examples. Having dealt with the method of arriving at cost figures, he then showed how by a careful study of those figures economies in working could be effected. He made recommendations as to the working of cupolas and compared different moulding materials and methods of moulding. Finally, he dealt with the economic disposition of labour and efficient methods of shop organisation.

The Queen Mary Reservoir Conduit.

No. I.

IN our issues of June 19th and 26th last we gave a description of the Queen Mary Reservoir at Littleton, in the Thames Valley, which was formally put into service by the King on June 13th. We explained that the aqueduct or conduit which is to convey the water from the reservoir to the various works of the Metropolitan Water Board, where it will be treated before being distributed, was not then finished, though work on it was proceeding. That work is now practically completed, and we give a description of it in what follows. The route taken by the conduit is shown in Fig. 5.

Our readers will remember that the water issues from the reservoir through twin 8ft. diameter reinforced concrete pipes which have their axes at + 35·5 O.D., and which pass under the reservoir embankment in a straight line and are then curved to pass under a roadway, quite close to which is a gauge basin from which connection is made with the open aqueduct coming from the Staines reservoirs. For the present one of these pipes is stopped with a tapered end which is furnished with a 48in. cap, it having been decided to leave till some future time the construction of a second 6ft. diameter pipe between this point and Kempton Park. The other pipe is continued, though with its diameter reduced to 6ft. The 8ft. diameter pipes are constructed as shown in Fig. 6, which indicates the method of reinforcement employed. The circumferential reinforcement consists of ⅜in. mild steel round bars bent to true circular form before being put in position and of sufficient length to overlap 2ft. and to have their ends bent hook shape. The overlap of adjacent hoops is on opposite sides and the space between the overlapping ends is not less than 1¼in. The hoops are at an average distance apart of 5¼in. and they have an outside diameter of 8ft. 10in. The longitudinal reinforcement consists first of three ⅝in. round rods at the top and three at the bottom, the middle of three, both at top and bottom, being arranged on the vertical centre line, the other rods being fixed at 1ft. centres on either side of the middle rod. The remainder of the longitudinal reinforcement consists of "deformed" or twisted bars having a sectional area of not less than 0·062 square inch, i.e., about ¼in. squared. These bars are arranged at not more than 6in. apart round the whole circle and are wired to each circumferential reinforcing bar at each point of intersection. We shall have more to say concerning the construction of these reinforced conduits when we come to deal with the 72in. pipe line. Meanwhile we may say that just before the gauge basin is reached each conduit is furnished with a 36in. cast iron manhole, which is let into the top of the conduit in the manner illustrated in Fig. 6. It will be observed that the lower part of the manhole is provided with a turned-up flange which is rectangular in plan. Where it came, eight of the circular reinforcing bars were cut and screwed. These screwed ends were passed through holes in the flange of the manhole and fastened by nuts. In the same way the ⅝in. longitudinal reinforcing rods were cut and screwed, passed through holes in the flange and secured by nuts. Six of the 0·062 square inch longitudinal reinforcing rods were cut with sufficient length to lap right round the flange. The outside faces of the flanges are formed with a groove, and right round the four faces of the flange folding wedges of wood were arranged, prior to pouring the concrete, so that their edges came flush with the internal surface of the pipe. When the concrete had set and was sufficiently hardened these wedges were withdrawn and the gaps so formed were carefully caulked with lead wool, so as to make sure that the joint between the concrete and the iron was water-tight. The same procedure was followed at all points in the length of the conduit where manholes are placed or where branches are taken off.

The first two branches are taken off a short distance beyond the manholes referred to above, and they are for the purpose of making connection with the Staines reservoirs aqueduct. Both branches—one from each of the 8ft. diameter conduits—are 48in. in diameter, and the junctions with the conduits are formed in a manner identical with that used for the manholes, as will be seen from Figs. 6 and 7. They are led away from the lower sides of the conduit and are each furnished with a 48in. sluice valve, the spindle of which is taken up above ground level, where there is the usual hand-operated headstock. On the far side of each valve is fitted a short length of pipe having a bell mouth, which is taken through the wall of the entrance chamber or well of the gauge basin. The floor of this entrance chamber stands at 25·00 O.D. The level of the floor of the gauge basin proper is 39·00 O.D., or approximately that of the invert of the adjacent open aqueduct, so that the entrance chamber is 14ft. deeper than the gauge basin. This depth is due to the level of the 48in. branches from the conduit. The depth of the entrance basin incidentally assists in steadying the discharge from the conduit before it enters the gauge basin. The entrance chamber measures some 16ft. by 8ft., and its upper part, which is open to the air so that destritus may be removed by grabs, is divided into two by a central wall, which is in the form of an arch.

The arrangement of the gauge basin is shown in Figs. 8 and 9. The water coming from the entrance chamber enters it at right angles to its length, the enclosing wall being curved at a radius of 15ft. In order to prevent surging of the water a series of five baffles has been formed in the length of the basin. Three of these baffles are led up from the floor of the

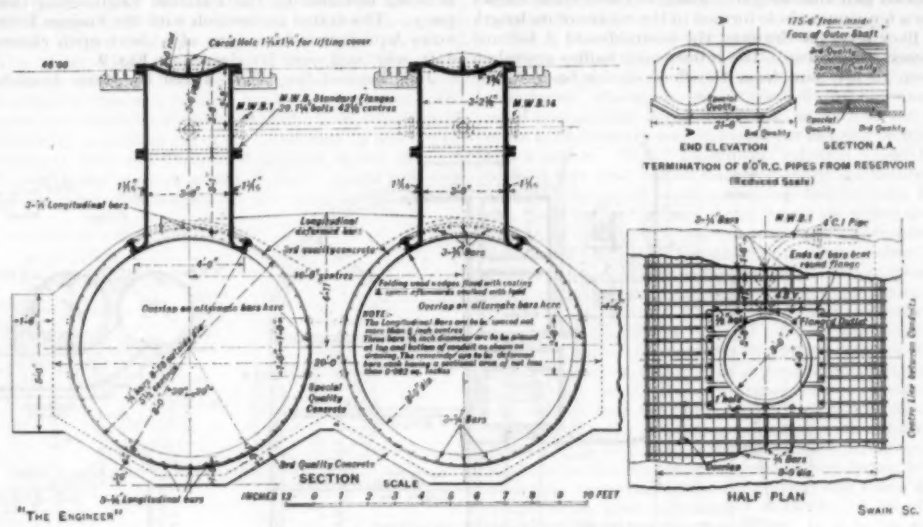


FIG. 6—36in. MANHOLES FOR 8ft. CONDUITS

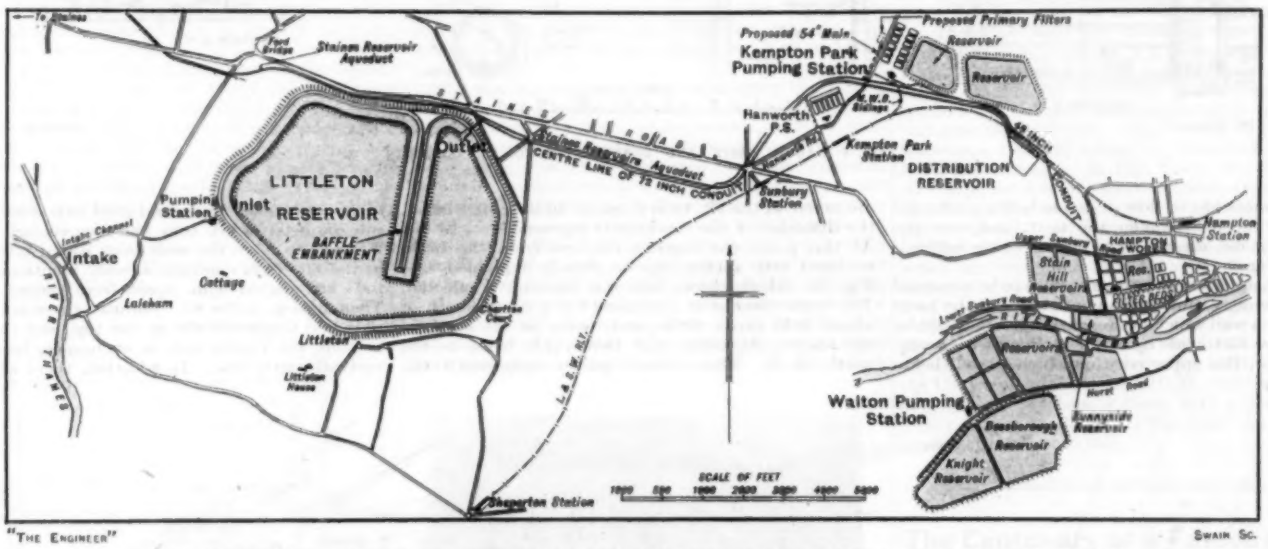


FIG. 5—SKETCH MAP SHOWING THE POSITION OF THE RESERVOIR AND THE ROUTE TAKEN BY THE CONDUIT

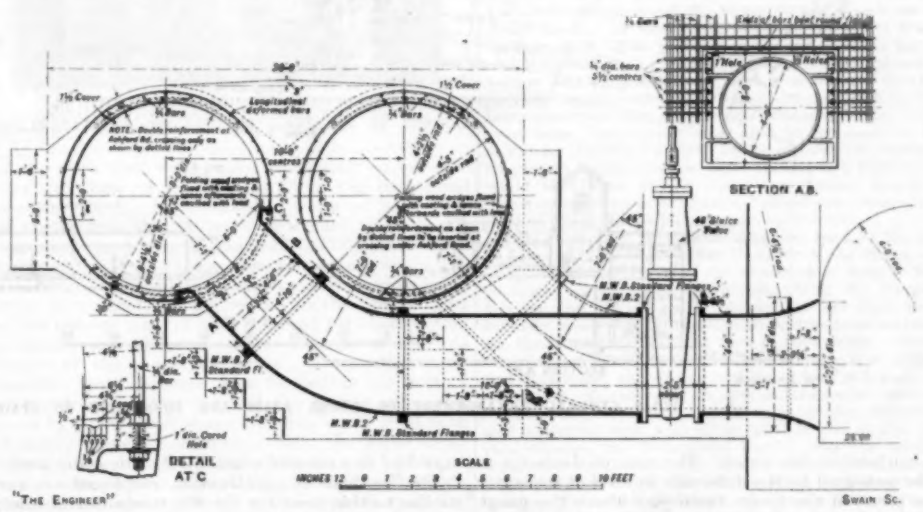


FIG. 7—48in. BRANCH PIPES FROM 8ft. CONDUITS

basin and the other two dip below the surface of the water, the upper and lower baffles alternating with one another. The first two of the baffles built up from the floor rise to a height of 4ft., while the third only rises to half that height. Each of these three baffles has a 6in. square hole formed in the centre of its length at floor level for draining the basin should it become necessary to do so. The intervening baffles are taken down to 3ft. 6in. from the floor of the basin. The incoming water has to flow over one baffle, under the next, over the next, under the next, and over the last before it can escape. The placing of the baffles is shown in Fig. 9.

The discharge from the gauge basin is to be measured in the following manner. The outlet end of the basin is closed by a wall which has formed in it a rectangular gauge orifice 13ft. wide by 2ft. deep lined with a gun-metal frame, the upper edge of which is well below the surface of the water. The rate of discharge is to be measured by the difference in level of the water at a point in the gauge basin just above the gauge orifice and at a point in the outlet channel some 48ft. beyond the gauge orifice. For this purpose there are two sumps, one where communication is made with the gauge basin and the other where communication is made with the outlet channel, the connection in each case being by means of pipes. From each of these sumps a 4in. gauge pipe is led back to a gauge house, which is built adjoining the entrance chamber and are taken off the 8ft. twin conduits to the gauge basin, the diameter of the conduits is tapered down to 6ft. At this point the conduit furthest from the basin is closed with a 48in. cap, as already explained—see Fig. 10—which shows how the tapering is effected. The other conduit is continued for a total length of about 3840 yards, 1990 yards being to the south of the Staines Aqueduct and 1850 yards being to the north of it. The conduit passes underneath the aqueduct in a manner which we shall describe later.

The method of construction employed is very similar to that used for the 8ft. conduits and briefly referred to above. The conduit is, as already explained, of reinforced concrete, the proportions of the concrete which were rigidly adhered to, being as follows:—Cement, 200 lb.; shingle, 6¾ cubic feet; sand, 3¾ cubic feet; Buxton lime, 15 lb.

Some of the shingle and sand for the special quality concrete used for the construction of the pipe were obtained from the material excavated from the trench dug to contain the conduit, the shingle and the sand being separated by screens and washed on the site, but the greater quantity was supplied from local pits, as that course was found more economical. The shingle employed was that which would pass through a ¾in. square mesh and be retained on a $^{3}/_{16}$in. square mesh, while the sand had to pass through a $^{3}/_{16}$in. square mesh. The reinforcement is both longitudinal and circumferential. The circumferential reinforcement consists of ¾in. round steel rods bent to an outside diameter of 6ft. 10in. and long enough to overlap 2ft. and to have the ends bent round into hooks as in the 8ft. twin conduits already mentioned. These rods are spaced 6½in. apart from centre to centre. Then, also as in the 8ft. conduits, there are three ¾in. rods laid longitudinally at the top, and three at the bottom, the centre rod, in each case, being on the vertical centre line. In addition, there are 36 "deformed" or twisted rods, each having a cross sectional area of 0·062 square inches, which are equally spaced round the circumference, two at the top and two at the bottom coming centrally between the centre and outer ¾in. longitudinal rods. At each point where a longitudinal rod crosses a circumferential rod, the two are securely wired together, accurate spacing being insured by the man, doing the wiring, holding the circumferential rods apart by a gauge. At all road crossings and under the reservoir embankment an extra series of circumferential and longitudinal

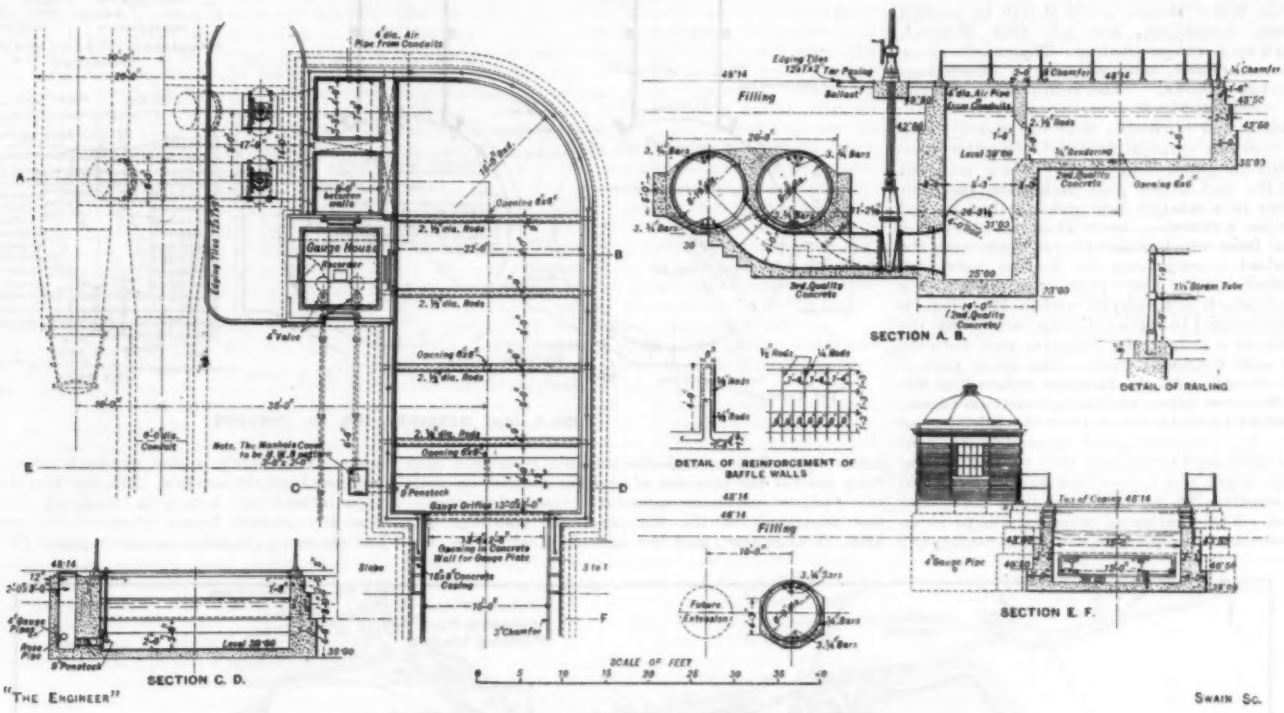


FIG. 8—GAUGE BASIN AND CONNECTIONS TO 8ft. CONDUITS

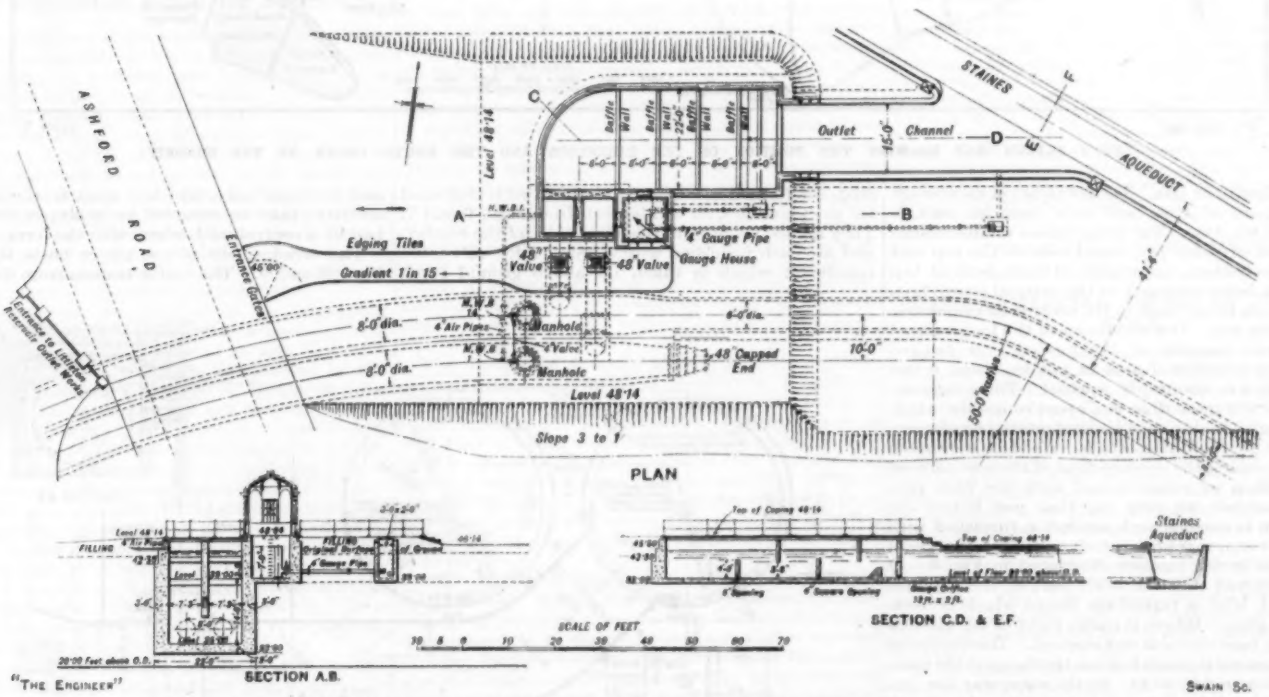


FIG. 9—GENERAL ARRANGEMENT OF GAUGE BASIN AND CONNECTION TO STAINES RESERVOIRS AQUEDUCT

reinforcements were placed at the invert and crown near the inner surface to afford additional strength against deflection due to external loading. On the occasions of our visits to the works while they were in progress we had opportunities of watching the process of fixing the reinforcement, and were struck with the speed and accuracy with which the work was done. In order that the circumferential rods might be arranged approximately in position before the longitudinal wires were wired in place, a simple but effective gauge was employed at the bottom of the excavation. It consisted of what may be termed a species of duck boarding made up of a series of boards, of a width corresponding with the distance apart it was desired to have the rods, these boards being secured—

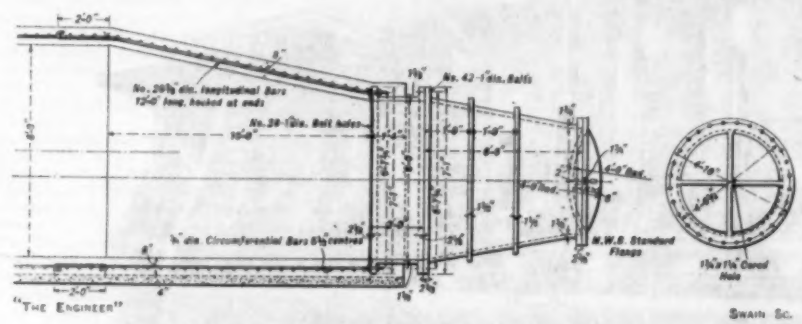


FIG. 10—TAPERED AND CLOSED END OF 8ft. CONDUIT

transversely to the axis of the pipe—to horizontal runners, with a space between them sufficient to receive the reinforcing rods. Then, at each horizontal semi-diameter of the tube there were arranged along the sides of the excavation longitudinal timbers with slots cut in them, wide enough to receive the rods, and at the correct spacing. These timbers were fixed so that the bottom of each slot of the timber on one side of the trench was 6ft. 10in. from the bottom of the corresponding slot in the timber on the other side of the trench, that is to say, at a distance apart equal to the outside diameter of the reinforcing rod when bent into a circle. The approximate weight of reinforcement employed was 2½ cwt. per lineal yard. As the work of getting the reinforcement in place

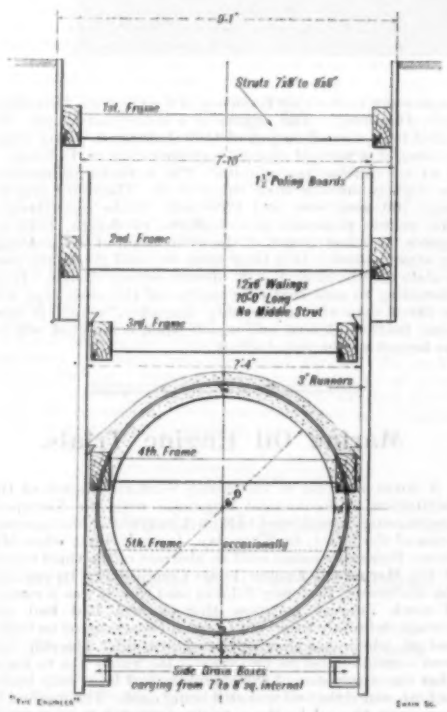


FIG. 11—TYPICAL TRENCH AND TIMBERING

proceeded and the rods were wired together, they were suspended by adjustable hangers of the third frame walings and/or from intermediate timbers bearing on the third frame walings. Then, after the conduit centering was fixed, as explained later, the final adjustment of the assembled steel was made.

The whole length of the 6ft. diameter conduit was laid in trench and then covered in, and only at one point, where it passed under the Hanworth-road and where it had to be taken under two pipes which were encountered, was the continuous regularity of its gradient broken. The excavation of the trench was carried out for the most part by grabs operated by steam-driven jib cranes. The material excavated was very largely gravel though, in places, the London clay was entered. The ballast was of excellent quality and furnished some of the shingle and sand and all the ballast required for the concrete work. The standing water level comes generally within but a few feet of the surface of the ground, and a large amount of pumping was continuously necessary in order to keep the trenches dry enough to work in. In all, no fewer than 32 separate pumps of sizes varying from 1in. to 15in. in diameter were in operation. The largest units and some of the smaller pumps were steam driven, but the majority operated on petrol. The water lifted, coming as it did from the gravel through which it had, probably, percolated for long distances, was of excellent quality, which was fortunate, for otherwise there would have been considerable difficulty in getting rid of it. As it was it was simply pumped into the Staines Aqueduct down which it flowed to be treated at the Board's works and used to augment the supply to the metropolis. Before the works were started the water entering the Staines Aqueduct from the river was chlorinated not far from the intake. During the construction of the new aqueduct, however, so as to make sure that the water pumped from the excavations, excellent in quality though it was known to be, should be sterilised, the chlorinating plant was moved down to a point below the workings.

The method employed for excavating the trench and for putting in the conduit is illustrated in Fig. 11, which shows a typical cross section, and is self-explanatory. We may remark, in passing, that we have never seen more elaborate or better executed timbering in any trench work. A noteworthy point was that by employing walings with a cross section of 12in. by 6in. and a length of only 10ft., it was only necessary to have struts at the ends, no middle strut being required. As a general rule, only four timber frames were needed, but not infrequently, where the ground was bad, it was necessary to fix a temporary fifth frame, as shown by broken lines in the section. The sumps from which the pumps drew were arranged about 100 yards apart. At the outset

FIG. 12—TAMPING CONCRETE IN HAUNCHES OF CONDUIT

of the work they were placed alternately on one side and the other of the trench, as it was considered necessary to check the inflow of water on both sides of the latter. As the work proceeded, however, it was discovered that it was sufficient to place them only on one side of the trench, and naturally the side nearer the Staines aqueduct was chosen as being more convenient, having regard to the limited area of the narrow strip of land acquired for construction purposes, and also, of course, because of the less length of the pump discharges. Three-sided close-boarded drain channels were formed at the bottom of the trench. The sides of the trench were also lined to a point well above standing water level with Willesden paper in continuous rolls, the paper being taken down into the drain channels. In addition to the water which entered the channels at the open end at the working face, a considerable quantity entered through the vertical joints of the runners. These side drains were led to the sumps, and where one drain crossed the trench for connection to the sump, the connection was made by means of a cast iron pipe. The bottom of the excavation was covered with a flooring of the cross section shown in Fig. 11, of what is termed third quality concrete, which is of the following mixture :—200 lb. of cement to 25 cubic feet of ballast. When it was well set, it was found quite effective for retaining the feet of the runners in position, so that the fourth frame of timber and the fifth, if any was necessary, might be struck so that there might be a clear way for assembling the steel reinforcement.

For a considerable portion of the length of the conduit collapsible steel "Blawform" centering was used though wood forms were employed for the remainder. The advantage of the collapsible centering is, of course, that it can be struck, as soon as the concrete is sufficiently set, and used for another length of the conduit. The "Blawform" drums when fully opened out and bolted together were suspended on hangers furnished with adjusting turnbuckles from the third frame timbers, holes being provided in the centering for hooking on the suspenders opposite the horizontal axis of the conduit. Then, when the concrete was placed up to that level, the suspenders were removed and the holes plugged up from the inside of the drums. The top half of the concreting was then proceeded with. The illustrations on page 126 show the methods of getting the centering into position, and also give a good idea of the reinforcement; while Fig. 12 shows how the concrete was tamped into the haunches of the conduit through side holes in the centering provided with removable shutters. Great care was exercised effectively to strut down the centering to prevent the drums lifting while the lower half of the concreting was being done. These struts were maintained until the crown of the conduit concreting was keyed in. It is to be noted that the level of the third frame timber was so arranged as to afford working room for placing the concrete arch below the struts and for holding the hangers for supporting the reinforcement and the centering. The length of concreting done during one day naturally varied, the greatest being 66ft., and the average about 50ft., and at each junction in the daily lengths of conduit formed there was a sheet lead joint. Referring in detail to the engravings on page 126, we may say that Fig. 1 shows several completed lengths of reinforcement with successive lead joints which give an idea of the length of conduit done at each setting of the centering. The gauge boards and timbers for holding the reinforcement during wiring will also be observed. Fig. 2 also shows the reinforcement and the collapsible drums of the "Blawform" centering. In Fig. 3 are seen on the right the flange for a 48in. cast iron branch pipe, and in the middle distance a length of the "Blawform" centering expanded. In Fig. 4 are shown, the flange for another 48in. branch pipe, on the left, and also the wood centering and reinforcement for the tapered end of the conduit where it is joined to a 48in. cast iron main, as we shall explain in due course.

Here it may be explained that the gradient employed throughout the length of the conduit, saving where it is in syphon, was 0·6 in 1000, the invert at the Littleton end being 31·50 O.D., while at the further end where a junction is made with a 48in. cast iron pipe line it is 24·35 O.D. The total fall in the 3840 yards is therefore 7·15ft.

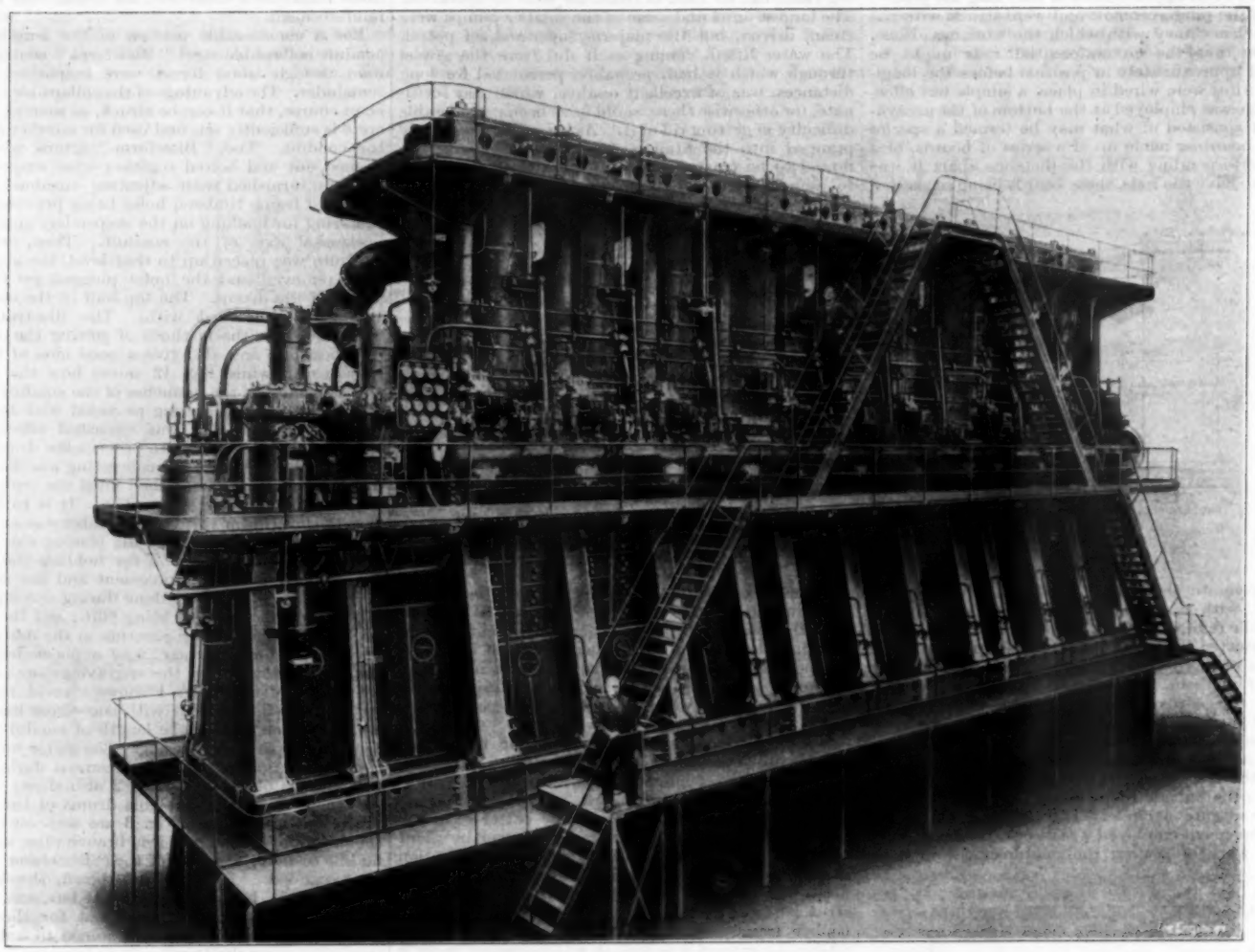
The Centenary of a Famous Bridge.

AT a time when Watt was busily engaged supplying engines to our mines, mills and breweries, and when Arkwright was organising his new factories, two young Scotchmen, both destined to become famous for their engineering works, made their way south. The younger of the two was John Rennie, whose crowning achievements were the Waterloo, Southwark and London bridges; the elder was Thomas Telford, afterwards the constructor of the great suspension bridge across the Menai Straits, which has now stood the test of time for a hundred years. It was on January 30th, 1826, just a century ago, that the London and Holyhead mail coach first crossed the bridge and the tedious and dangerous ferry became a thing of the past. Telford's suspension bridge was, in its day, as notable an achievement as were Stephenson's tubular bridge twenty years later, Ead's great steel arch at St. Louis of 1874 or Fowler and Baker's Forth Bridge of 1890. We have had no greater bridge builders than Telford and Rennie, and while the latter at his death was buried beside Sir Christopher Wren in St. Paul's, Telford was buried in the nave of Westminster Abbey close to Newton.

Like all the arts, bridge building goes back to the dawn of history. The name of the inventor of the bridge is as unknown as the names of the inventors of wheels, boats or looms. Assyria, Egypt, Persia, China, the Dyaks of Borneo, and the Aztecs of Mexico all had their bridge builders, while some of the Roman bridges have withstood the floods, earthquakes and wars of 2000 years. As with other human affairs, the art has had its periods of progress and decadence, and during the Dark Ages it lapsed into stagnation. The eleventh, twelfth and thirteenth centuries, however, saw its revival, and the semi-circular, the elliptic and segmental arch were all in use. It was at this time also, through the Benedictine monks, that the religious order, the Brothers of the Bridge, came into existence, their duty including the preservation and erection of bridges. Peter of Colechurch, who began the building of the Old London Bridge, is supposed to have belonged to this Order, and when he died in 1205 his remains were buried in a crypt of the chapel on the centre pier in accordance with the rules and customs of the Society. The director of the Order was called Pontifex Maximus, a title once applied by Southey to Telford. Right throughout the fifteenth and sixteenth centuries the Brothers of the Bridge exercised considerable influence on bridge building. Especially was this the case in France, and it

15,000 B.H.P. TWO-CYCLE DOUBLE-ACTING DIESEL ENGINE

BLOHM AND VOSS, HAMBURG, ENGINEERS



was in France in 1715 that we first see a Government department charged with the care of roads and bridges. Thirty years later from that department sprang the Ecole des Ponts et Chaussées, the first of our modern technical institutions concerned with the training of civil engineers. Perronet, builder of the Neuilly Bridge, was once director of this school, and many of Napoleon's engineers received instruction under him.

Up to this time practically all bridges were built of stone, and it was the work of the eighteenth and nineteenth centuries to introduce the use, first of cast iron, then of wrought iron, and of steel by which bridges of greater and greater span have been constructed. The great stone arch at Plaven is 295ft. span, but steel bridges exceed that by five or six times. Attempts were made to build iron bridges in Italy in the sixteenth century at about the time Palladio introduced the timber truss bridge and iron chain suspension bridges were used in Japan four or five centuries ago, but the first important iron bridge was that designed by Pritchard in 1773 and erected in cast iron by Abraham Darby in 1776. It still crosses the River Severn at Coalbrookdale: its span is just over 100ft. and the weight of metal 378 tons. Telford's Craigellachie Bridge of cast iron over the Spey had a span of 150ft., while Rennie's Southwark Bridge had spans of 210ft. and 240ft. and contained 5780 tons of iron. In 1896 there were no fewer than 2800 cast iron bridges on the English railway system, most of them, however, of small size.

For bridge construction wrought iron came in after cast iron, and for this purpose was in demand for some sixty to eighty years. Structural plates and bars were first made available through the epoch-making inventions of puddling and rolling by Henry Cort. With the new material new designs were possible, and suspension bridges, girder bridges, tubular bridges, truss bridges, arch bridges, and cantilever bridges were all built of wrought iron. First came the suspension bridges, and Telford's great bridge is of this type. A small iron chain suspension bridge had been in use as far back as 1741, enabling the miners to cross the Tees near Middleton. About the beginning of the nineteenth century James Finlay built chain bridges in America, and it was in America that we find the first example of an iron wire suspension bridge. Contemporary with it came Sir Samuel Brown's proposal of chains with flat bar links, and his large suspension bridge over the Tweed at Berwick had such chains. Moreover, this was the type of chain adopted by Telford for the Menai Bridge. Several schemes had been brought forward for a bridge over the Straits, and Telford's final plans included two towers, 150ft. high, supporting sixteen chains, the short spans being 280ft. wide and the centre span 580ft. The links of the chains have five flat bars, 3½in. wide and 1in. thick, 10ft. long, which are joined to the neighbouring links by plates 8in. by 16in. with 3in. pins. The cross section of the chains is 260 square inches and the total suspended weight 643 tons. Begun in 1819, the chains were lifted into place in 1825 and the following January the bridge was put into commission. Telford's Conway Bridge of the same time had a span of 327ft. Six or eight years later the Menai Bridge was surpassed by the Fribourg suspension bridge in Switzerland of 870ft. span, which remained the longest span of any kind in Europe till the end of last century. The Fribourg Bridge had iron wire cables, not chains. The great bridges at New York, *i.e.*, the Brooklyn of 1595ft., the Manhattan of 1475ft., and the Williamsburg of 1600ft. are all cable bridges, the cables of the last being 18in. in diameter.

A Large Double-acting Oil Engine.

PRELIMINARY tests were recently completed at the yard of Blohm and Voss, Hamburg, of a nine-cylinder double-acting two-cycle oil engine built under licence from the M.A.N. Company, Augsburg. It is, so the makers claim, the largest unit yet constructed, either for land or marine work. The accompanying illustration shows the engine as erected for testing at the builders' works. It will be employed for driving a 10,000-kilowatt alternator at the Neuhof Electricity Works, Hamburg. Some of the principal particulars of the set are given below:—

Engine Particulars.

Total designed output	15,000 B.H.P.
Number of cylinders	9
Cylinder diameter	860 mm.
Piston stroke	1500 mm.
Normal speed	94 r.p.m.
Overall length to generator coupling	23·4 m.
Overall breadth	4·3 m.
Height from centre of crank shaft to the top of the valve gear	10 m.
Overall height, including oil sump of bed-plate	11·8 m.

Generator Particulars.

Normal output	10,000 kilowatts
Voltage	5000–6000 volts
Periodicity	50 cycles

The generator has been designed and built by the Siemens Schuckert Company, of Berlin. It is water cooled, and presents several new and interesting features.

With the engine arranged as shown in the accompanying illustration, it was not possible—owing to lack of sufficient load—to measure the full power, but we learn that very satisfactory running tests were carried out, and the power was taken first with the upper and then with the lower ends of the cylinders in operation.

When the engine has been re-erected in the Neuhof power station, full electrical tests will be carried out, and we hope to give detailed particulars of both the engine and generator, together with some of the test results, in a few months' time.

We recently had the pleasure of witnessing at Augsburg the preliminary trials of an engine of a similar design, which was built by the M.A.N. Works, Augsburg, for the single-screw motor ship Rameses, of the German-Australian Line, Hamburg. The engine is a six-cylinder unit, designed for a normal output of 4400 shaft horse-power when running at a normal speed—corresponding to 13 knots—of 84 revolutions per minute. The cylinder dimensions are slightly smaller than those of the Hamburg engine, being 700 mm. bore and 1200 mm. stroke respectively. This engine possesses new features of design, both as regards the construction of the cylinders and the scavenging arrangement. In a later issue we shall give some particulars of the new M.A.N. double-acting design. It is interesting to note that four engines of the same type will be fitted into the motor ship Augustus, which is now being built at Genoa, and which when completed will be the largest motor vessel afloat.

Marine Oil Engine Trials.

A JOINT meeting of the North-Western Branch of the Institution of Mechanical Engineers with the Liverpool Engineering Society was held in Liverpool at the meeting room of the latter, on Thursday, January 14th, when Mr. Sterry Baines Freeman read an abstract of the third report of the Marine Oil Engine Trials Committee. In opening the discussion, Professor Scholes said that it was a matter of much interest to know that a firm had had the courage definitely to set out to run a Diesel engine on boiler fuel oil, which was cheaper than Diesel oil. The ship had been commissioned for two years. He would like to know what the experience of the engineers had been with boiler fuel oil, and if that oil was still being used. The method of measuring the oil in these trials showed a very marked improvement on the other methods which had previously been adopted. On the two previous occasions he had asked that light spring diagrams should be given. If he had his choice between a heavy spring diagram and a light one, he would choose the light spring diagram every time. Further, light spring diagrams should, if possible, be included. He admired the very ingenious indicator gear which had been used. The method of using the cam to give relative displacement was a method which called for favourable comment. The diagrams themselves were very interesting, because they showed that no attempt was made to reproduce what was generally acknowledged as a Diesel cycle. The cards themselves indicated a pure Otto cycle. That was borne out by comparing the compression pressure with the maximum pressure. In the Diesel cycle the maximum pressure would remain at the compression pressure. Another point which might be mentioned was the fact that the maximum economy occurred at a shaft horse-power development of about 1600. One would imagine that a marine engine, when once it got away from the dock, was opened out to practically full power, which would give a maximum fuel efficiency.

Mr. P. Youngson said that in none of the descriptions of

the Doxford engines that he had seen had there been an exact description of the engine. Was it not rather a semi-Diesel than a Diesel engine? Three hundred and fifty pounds was given as the maximum air pressure. That would correspond to an air temperature of somewhat under 1000 deg. Fah. Was that heat sufficient to ignite the charge? He also understood that somewhere in the combustion chamber there was some form of hot spot. In the paper it said that the gas was ignited by the compression of the air. Was it not the dual effect of the compression of the air and that so-called hot spot? He would like to know the average time in which the engine could be started up from cold. The mean effective pressures as given were average. They knew that in the Cammell Laird engine there was 10 per cent. difference in the power between the top piston and the bottom piston, owing to the obliquity of the connecting-rod and the fact that while the fuel was being admitted the bottom piston was travelling faster than the top piston. The oil was therefore cut off sooner from the top piston than from the bottom one. That difference might not be quite so great in a Doxford engine because the length of the bottom piston connecting-rod was about 4 to 1, and of the side rods about 6 to 1. He would like to know what was the difference in the power taken from the top piston and the bottom piston.

Captain Robinson said that in the exhaust gas observations—Table XIV., page 58—he noticed that the average temperature was given in Trial A as 636. At the end of the exhaust manifold it was apparently 693. Was it possible that there was some mistake in the figures, or was there some increase in the combustion taking place in the manifold?

Mr. Okill asked how the injection pressures were measured. Was the pressure in the rail steady enough to enable it to be measured by an ordinary gauge? Could Mr. Freeman also tell them about the difficulties experienced with solid injection—he supposed there were some—*i.e.*, whether the sprays become choked, and, if so, what happened? In the Doxford system, did injection take place through a single orifice, or was there a series of orifices in front of the fuel valve itself?

Mr. Kirkpatrick, turning to page 62 of the report, quoted: "It will be noticed that the maximum pressure during firing was raised from 570 lb. per square inch (normal conditions) to 670 lb. per square inch, with a consequent reduction in the fuel consumption." Had Mr. Freeman, in any of his trials, tried any supercharging, *i.e.*, putting the scavenging gas in at a pressure of 1·5 atmospheres?

Mr. Freeman, in reply to the discussion, said that Professor Scholes had spoken about the boiler fuel oil and of the experience in using it. That depended on what boiler fuel oil was. He thought what was described in the report was quite a fair sample. Those Doxford engines were running with a lower class of oil than a great number of other vessels, owing to the fact that they were running on the American coast. An engine which took fuel at the top of the cylinder and passed it out at the lower end was in a better position to deal with boiler oil than an engine which had to pass it back to an exhaust valve. The owners had had no experience of using a really bad boiler oil. A great deal of boiler fuel oil had been sold as Diesel engine oil, and *vice versâ*. The experience of the engineers was that they were doing quite well on the boiler fuel oil shown in the report. Professor Scholes had raised the point, and a subsequent speaker had also raised it, as to whether that engine was a pure Diesel engine; it was really of the semi-Diesel type. Mr. Fyffe had asked about cleanliness of the engine after running on boiler fuel oil. Mr. Freeman said he had seen an engine opened up after running on boiler oil, and the difference between that and the engine running on clean oil was very great. They had to pay the penalty in the ordinary engine for using the boiler fuel oil, and they would have trouble with fuel valves if they were not adjusted for using that particular class of oil. Mr. Youngson had asked the average time to start up from cold. Mr. Freeman replied that he did not believe the engines were started from cold; he believed hot water was circulated through the jackets before starting. Nowadays, they were getting past a stage when a decimal point in consumption weighed heavily with any purchaser. There was more interest in reliability than in very low consumption.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Foreign Competition in the Engineering Trades.

THE Birmingham district possesses in its midst several engineering firms which from personal acquaintance with engineering conditions broad are well qualified to rank as authorities on the question of foreign competition. Peculiarly prominent amongst these firms at the present time is John Thompson (Wolverhampton), Ltd., which for years past has been accustomed to send its principals personally to travel in Europe on trade missions. The firm during the last three years has extended its directors' intimate knowledge to Australia and South Africa. Nearly two years were spent in the former country and twelve months in the latter. Owing to this valuable travelling experience peculiar importance attaches to some remarks on foreign competition made last week by Mr. James Thompson, chairman of the firm, at a semi-public function held to celebrate his return from South Africa. Dealing with trading conditions existing at present in the industrial world, Mr. Thompson declared himself by no means pessimistic. This country, like many others, had been, he said, and was still passing through a very trying period, but he refused to believe that we had arrived at the condition of being "played out," or ever would be. From his experience in the Dominions he had an infinite belief in the prestige of British products and the ability of Great Britain to hold its own in the markets of the world. British products could always be sold in the Dominions in preference to those of either America or Germany wherever a first-class article was offered at a reasonably competitive price. As concerned American competition generally, his own knowledge convinced him that there was no justification for believing otherwise than that we should still be able successfully to combat it. At times we were able to beat them even in their own country, and that in spite of their very heavy tariffs. In future we should not be so dependent upon America for so much raw material, and indeed, if we were, the States would not be able to supply it. German competition was felt in some branches of the engineering trades, but that was nothing new, and the pinch would be felt again. There was, however, a limit to the low prices which they had recently been asking. The German banks had already called a halt to German manufacturers, with, as a result, enormous losses to some of the great firms there. British master engineers must, said Mr. Thompson, foster the persuasion that we must and should again "win through" to the proud eminence which this country had held for so long. The peculiar worth of British engineering products had always justified this unique confidence, and he for one was sure that the boast could still be maintained. He was prepared to declare that British producers had a great pull over their foreign competitors in the historic integrity of their business relations. A British master engineer's word was still his bond.

Market Situation.

There is no great amount of new business passing in the Midland iron and steel industries, but the market is somewhat stronger in certain directions. The general tone is fairly healthy, though the uneasy feeling as to the coal situation, in conjunction with the rising price of coke and the possibility of strife in the engineering world over wages questions, prevents both producers and consumers of iron and steel from negotiating forward contracts. Local engineers' hopes have been strengthened by orders given out by the railway companies. Some of them have come to the Staffordshire district, and others are expected. Structural engineers have been doing better of late. Things are going well in the carriage and wagon shops, additional orders having been received from British railways, as well as from India, South Africa, and South America. In the Staffordshire iron trade nearly all the mills could do with more work, and the prospect of increased competition from the Continent in common bars is viewed with some alarm.

Raw Iron Prices Advance.

Midland raw iron prices have stiffened further, under the influence of dearer furnace coke, and the better balance which has been established between demand and supply. Blast-furnace coke, which was obtainable last quarter at 13s., is now 14s. 6d. per ton, and the increased call on the fuel trade for domestic supplies has given it a better paying market, so that there is a prospect of coke values going still higher. Under these circumstances some Midland furnacemen quote prices 1s. to 1s. 6d. above the quarter-day figures, and the basis on which business is done shows an advance of 6d. to 1s.; Derbyshire No. 3 foundry is £3 7s. 6d.; while Northamptonshire houses ask £3 5s. Forge prices are irregular, and little business is being done. Derbyshire makes are quoted £3 4s., but this is above the ideas of forgemen, who are not so favourably placed as foundrymen. Northamptonshire makes are offered at £2 16s.; the minimum, however, is £2 15s. A fair amount of pig iron, estimated in relation to the restricted output, has been bought at the lower rates ruling a few weeks ago. Some furnaces are limiting commitments to the end of March, for, in the present unsettled condition of the fuel trade, there is no disposition to take risks. The prevailing uncertainty as to fuel, together with the absence of any new impulse in the demand for pig iron, deters smelters in the Midland area from putting more furnaces into commission.

Finished Iron.

There is no change of moment in the Staffordshire finished iron trade. Business continues poor, and some important inquiries received in December having failed to yield business, many of the mills are unable to make full time. A fair quantity of iron and steel is being taken from the Black Country for wagon building purposes, and miscellaneous railway requirements are finding some useful work. Marked bars remain at £14, while Crown qualities, under the stress of Lancashire competition, continue to be sold at £10 10s., though the official quotation is £11. Everything points to the fact that the near future will witness the delivery in the Midlands of larger quantities of foreign nut and bolt iron, which have lately been irregular and often very belated owing to the labour troubles in Belgium. Advices received in Birmingham indicate that a number of continental works which have been idle are now to be restarted. Belgian No. 3 iron is offered at about £7 delivered, while Staffordshire common iron commands about £10 10s.

Steel Business.

In the steel department the stage has obviously not been reached when price advances can be made with any confidence. A few firms have been able to obtain small increases in joists and sections, the department most affected by building and structural activity; but the bar department is weak, largely because of the competition of re-rollers, who are complaining of falling prices. One large firm is taking orders at £7 15s., whereas the recent figures were successively £8 and £7 17s. 6d. This keen cutting is facilitated by the use of Belgian semi finished steel. Undercutting continues with regard to plates, ship, bridge and tank plates ranging in price from £7 15s. to £8. Boiler plates are in the neighbourhood of £11. Staffordshire hoops are quoted £10 10s. at works. The recent advance in the price of foreign steel appears to have been checked—partly on account of the breakdown of the Charleroi strike, after continuing for over six months—which has greatly increased the supply of continental steel. Midland steel mills are busier over a wide range of products, the demand being insufficient to absorb the output of the mills. Requirements for building operations steadily expand, and rollers of joists and sections are now being called upon for supplies, some of this business being captured from the Continent.

Declining Sheet Values.

The galvanised sheet trade is well employed, chiefly on old contracts, new business being of moderate dimensions, although fairly representative of the usual market. Values, however, are on the decline. Not many weeks ago £16 15s. was the accepted basis for 24-gauge corrugateds, and recently quotations were reduced, by mills anxious to do business, to £16 10s., and this week a further cut of half-a-crown has brought the minimum to £16 7s. 6d. There are mills which still quote £16 15s., but ample supplies can be secured at seven shillings and six pence below that figure. Black sheets are called for in good quantities. The prices for tinned sheets remain unchanged.

Birmingham's Business with the States.

The returns of exports from the Birmingham area to the United States of America furnished by the American Consul at Birmingham show encouraging evidence of expansion. The figures for the past year record an increase in value, compared with 1924, of 35 per cent., the main impetus being developed in the last quarter, which was over 85 per cent. ahead of the corresponding quarter of the previous year. The twelve months' exports reached a total value of 8,651,192 dollars, against 6,372,116 dollars in 1924, roughly £1,900,000, against £1,400,000, but this comparison does not take into account the appreciation of sterling, which made the exchange rate about 5 per cent. more in the last quarter than in the corresponding quarter of the previous year. There was an advance in the value of exports of machinery and vehicles from 91,631 dollars in 1924 to 379,663 dollars in 1925. This was due to some extent to the dispatch from this district of a considerable amount of machinery for the installation of another artificial silk factory. It is worthy of note that more automobiles were sold to American buyers, but they had only a minor part in the increase. There was a promising advance in iron and steel manufactures, the value being 313,341, against 263,618 dollars. Exports of metal manufactures were nearly twice as large, 812,589, against 413,585 dollars.

New Factory for Stoke-on-Trent.

I learn that the Michelin Tire Company has decided, subject to the approval of the site by its technical advisers, to build its large new English factory at Stoke-on-Trent. The factory, it is understood, is to cost fully half a million of money, and when building operations are completed, at the end of five years, between 8000 and 10,000 workpeople will be found employment. As only pivotal men are being imported, and the rest of the labour is unskilled, the unemployed problem for the Potteries will be completely solved. The site upon which the factory will be erected is over 180 acres in extent, and is alongside the London, Midland and Scottish Railway line, which passes through Stoke-on-Trent from Manchester to London, so that transport facilities are excellent. The company expects to commence production in the spring of next year, and the output will be steadily increased as building operations progress.

The Electricity Scheme.

Considerable attention continues to be given to the Government's electricity proposals, and it has been pointed out by Alderman J. B. Burman, a former chairman of the Birmingham Electricity Supply Committee, that the standard of frequency in Birmingham is not the same as in the majority of areas of the country, and if the proposed new Board of Control should require them to standardise it, it would mean enormous expense. The cost of the change in Birmingham had been estimated at £6,700,000. It is not at all clear how it is proposed to deal with great undertakings like that at Birmingham, developed at enormous cost on a basis which conflicts with the Government plan for a uniform frequency of fifty. It is inferred, however, that the operation is to be effected gradually, as existing plants need renewal. A scheme of such magnitude will obviously put a heavy strain on the electrical engineering industry, and it would seem natural to apply its resources first to making good under-development and inefficiency, leaving highly equipped undertakings like that at Birmingham to be dealt with as the economic life of the existing plant runs out.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

The General Outlook.

THERE has been a better undercurrent since the Birmingham quarterly meeting in both iron and steel, and whilst the volume of actual business has not been particularly large, inquiries have been fairly satisfactory. There have, however, been few important changes to note in any department. Various leaders in the industrial world appear to have been indulging in prophecy, but, taken all round, there seems to be a consensus of opinion that things are not so bad as has been represented in certain quarters. It cannot be denied, however, that the production of pig iron and steel in the North has shown a serious diminution and the head of one of the largest metal agencies in this centre describes the trade as unprofitable, steel prices being only 18.5 per cent. above those of 1913. In spite of financial sacrifices it has been impossible to maintain the volume of production in 1914. Continental competition, helped by lower wages, longer working hours, and more reasonable transport costs, was exceedingly keen. This fact was also emphasised by the shipping trade, though it was stated there were more inquiries for new ships coming forward. The past year has been one of difficulty to the engineering industry, but a steady improvement was reported in the volume of orders for engineering and kindred products from overseas. There is some improvement to note in the demand for textile machinery, though, as in other branches of the trade, business is affected by the uncertain position of labour.

Metals.

On spot there is little change to note in the position of non-ferrous metals, but with regard to copper the weaker feeling noted in the American market is reflected here. There is no disposition on the part of merchants to meet buyers, and the tone steadied somewhat under more conservative offerings on the part of larger dealers. Best selected copper ingots were quoted at £65 10s. and electrolytic firmed up to £66 10s. The basic price for copper tubes remains at 1s. 1d. and brass tubes 1s., with condenser around 1s. 2¼d. per pound. Tin is offered more freely, with buyers showing more inclination to operate at the lower prices ruling. Pig lead shows a rather sharp reduction.

Pig Iron.

The upward trend of prices of pig iron continues, but buyers show little inclination to operate except for immediate requirements and there was an absence of speculative business. In some quarters the tone is of an optimistic character, inquiries being very satisfactory, and some substantial orders are reported to have been booked. There is still much room for improvement, and it is estimated that fully one-third of the blast-furnaces in this country are out of action. Quotations for Lincolnshire No. 3 foundry are around 76s.; Derbyshire, 76s.; and Cleveland, 82s. per ton delivered Manchester. The present high prices of Scotch foundry iron militate against demand.

Finished Material.

There is little or no change to note in the position of finished iron and steel. In some directions prospects are somewhat brighter, but the unsettled state of the weather is holding up the building trade. Some fair orders are reported to have been booked, however, for constructional material.

Scrap.

Demand for scrap generally is on the quiet side, and while some high prices are reported to have been paid, these transactions are regarded as more of a speculative character. There is, however, no giving way in prices, and for heavy steel melting scrap quotations are well maintained at 57s. 6d. on trucks, Manchester. Other descriptions of steel scrap range from 55s. to 57s. 6d. f.o.t. There is a distinctly firmer feeling in raw scrap, heavy being quoted 65s. f.o.t. Manchester. In the cast scrap market prices have a wide range, anything from 70s. to 77s. 6d. being asked and paid for textile material.

Fuel.

The attendance on the Manchester Coal Exchange on Tuesday was well up to the average. So far as house coal was concerned the milder weather was responsible for some falling off in demand, though best qualities were in rather small compass. Slack and industrial fuel continues quiet. Furnace coke remains firm.

Institution of Mechanical Engineers.

At the annual meeting of the North-Western Branch of the Institution of Mechanical Engineers, held in Manchester on Thursday, 21st inst., it was stated in the Committee's report that three out of five awards made by the Institution during the year fell to graduates of this branch, namely, Mr. E. H. Lewis, M.Sc., for a paper on "The Reduction of Factory Costs"; Mr. F. W. L. Heathcote, B.Sc., on "Involute Gearing"; and Mr. J. B. Cushing, B.Sc., for a paper on "The Erection of Steam Turbine Plants on Site." The total membership of the branch for the year ending 1925 was 1129, compared with 1102 at the end of 1924, and of that total 241 are members of the Graduates' Section. During the year twelve regular meetings of the corporate members of the branch were held, two of them in Liverpool, and the average attendance of members and visitors was 110. Mr. C. Bentham, of Henry Simon, Ltd., was elected chairman of the branch for the ensuing year, and the following gentlemen were elected on to the local Committee:—Messrs. H. L. Guy and E. T. Kersey, in addition to Messrs. Dempster Smith, G. Stoney, and H. Richardson, who were re-elected.

New Artificial Silk Factory.

A new artificial silk factory is to be started at St. Helens, Lancashire, the old Sutton Glass Works, belonging to Messrs. Pilkington Brothers, having been purchased for the purpose. The site is well situated for water supplies, and there is plenty of land adjacent for extensions.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade in the north-west district continues in the same tone. There has been no increase of output, for the demand does not quite merit it at present, though inquiries are fairly numerous and orders are being placed for forward delivery. The question as to whether there will be a further improvement in trade, generally, in the near future, remains to be seen, but the threat of stoppage arising out of the coal trouble is certainly having a restraining influence at the moment, though it would be difficult to say exactly how much. It is hoped that, when the coal trouble has been got over, the business in the district will improve. Makers at Barrow and Workington are sending part of their output to the steel departments, and that accounts for a proportion of the output and keeps down stocks. Continental trade is dull, but business with America continues. There was a part cargo from Barrow to Philadelphia of pig iron last week. The fact that Japan is not putting the 12 per cent. tariff on iron is welcome news for there are occasional dispatches from here for Kobe.

Iron Ore.

The iron ore trade is moderately employed, and there is a certain amount of iron going out of the district, but in the latter trade there is room for further expansion. Foreign ores are required, and orders have been placed and charters entered into.

Steel.

The position in the steel trade is a little better, and Barrow is sharing in the order for rails from the North-Eastern. There is some talk of a Japanese order for rails, but there is nothing definite as yet. It is said that the American rails used in Japan are not standing up to their work. The Workington rail mills are only working three weeks out of the four, but work at Barrow is continuous at present.

Shipbuilding.

The order for another Donaldson liner, booked by Vickers Ltd., is very welcome. This ship will be sister ship to the Moveria, which was completed over a year ago. She will be driven by a single set of Vickers solid injection internal combustion engines, similar to those of the Moveria.

SHEFFIELD.

(From our own Correspondent.)

No Steel Revival Yet.

THE first month of the year has brought no improvement in the heavy steel trades of Sheffield and district. Some departments are just about holding their own, but others, and not unimportant ones either, are less busy than they were at the close of last year. This is anything but a cheerful start, but it does not appear to have lessened the feeling of confidence among manufacturers that a forward movement will develop. The National Federation of Iron and Steel Manufacturers has published a complete analysis of those industries in Great Britain for 1924. These statistics are usually about a year old before they appear, owing to the great amount of work and detail involved in their preparation, but they are of enormous value for record purposes. The total production of steel for 1924 was 7,307,400 tons and of that quantity Sheffield accounted for practically one-seventh, or, to give the exact figures, 1,031,100 tons. The steel production in Lincolnshire amounted to 466,100 tons. In the whole of Great Britain there were 665 furnaces, and 109 of them were in the Sheffield district. The number to-day is even greater, and when it is mentioned that the number of furnaces in the year before the war was 72, it will be readily appreciated how great a development in the steel trade there will have to be to-day if profitable work is to be found for all these furnaces. Coming to more recent figures, those for last year show that other steel and pig iron producing countries made considerable headway in the matter of output. The United States produced its record quantity of steel, the French output was greater than that of this country, and for the first time in history her exports equalled those of Great Britain. Germany's largest production of iron and steel since the war was reached in 1925.

Engineering Departments.

Although the engineering departments are not particularly busy, there is good reason to believe that they will secure a good deal of extra work in the near future. A lot of constructional and engineering contracts have been placed lately, and the city and district should get its share of this work. The Leeds Forge Company, Ltd., which is part of the firm of Cammell Laird and Co., Ltd., has received an order from the Compagnie Internationale des Wagon-lits for thirty all-steel Pullman cars for use on the Continent, and another Leeds firm, Kitson and Co., Ltd., engineers, of the Airedale Foundry, has received an order for four locomotives of the special Kitson-Meyer articulated type for the Girardot of Colombia. These engines are specially designed for the mountain railway which runs from Girardot to Facatativa, a distance of 75 miles. It rises to a height of 9000ft., has gradients as steep as 1 in 25, and has sharp curves. About twenty engines of similar type for this line have already been supplied by this firm. Edgar Allen and Co., Ltd., of Sheffield, who are engaged on contracts for the manufacture of cement making plant, lime-burning kilns and other similar plants, are now at work on a large rotary kiln for lime burning for India. America has been using this method of burning lime for some years, and the results are stated to be satisfactory and economical. The kiln which is being made by this company is 165ft. long, with a diameter of 7ft. 6in. The burning zone is enlarged to 8ft. 6in. diameter, while the lower 25ft. of the kiln is arranged to act as a cooler to the hot lime before it leaves the end of the kiln. Fire-brick lines the kiln throughout, and included in the plant is a pulverised coal equipment, consisting of two turbo-pulverisers, each of which is of sufficient capacity to supply the kiln with fuel and leave the other as a stand-by.

Tools, Plate and Cutlery.

The inquiry for steel tools of all descriptions has been remarkably heavy during the past few weeks. No one, of course, expects them all to materialise into actual orders, but it is significant that these inquiries are considerably in excess of the average number that come through at this time of the year. The cost of tools from the United States has risen, that of German tools gives promise of rising, and with the Sheffield product so much superior in quality there can be no question as to who can benefit by this levelling of prices. This year again Russia is going to be a large buyer of Sheffield files, saws, edge tools and tool steel. Exports to that country have been proceeding throughout the winter, and a lot of additional work has now been placed for delivery as soon as the sea route re-opens. The one unsatisfactory feature about the tool trade last year was the smallness of profits, but makers believe that the present year will be more satisfactory in that respect. Plate and cutlery manufacturers are not anticipating either a very busy or a very prosperous year. Few orders have come through since the stoppage after Christmas, and the works have barely got going again. Thanks to the operation of the new duties on cutlery, imports are now almost insignificant, but with the country overloaded with stocks of foreign articles, chiefly German, the Sheffield industry does not expect to have a busy year. Table cutlery is not so largely affected in this respect, but the works are comparatively inactive at the moment.

Sheffield Steel Products.

Shareholders of Sheffield Steel Products, Ltd., were informed at the annual meeting that the past year had been to a very large extent occupied in organisation. "We are carrying out a policy of concentration," stated the chairman, "with the object of effecting economies in working, and this has also cost money and means a certain amount of dislocation of trade. The sales for the year show an encouraging increase over those of the previous year, and the increase is still continuing. Competitive selling prices have, however, fallen from 5 to 10 per cent., and it is fortunate for us that the efforts of the management have been able to secure an increased volume of business. In the home trade we have more than doubled our outside sales force, and we are now represented in practically every country in the world." Adding a few words as to the difficulties facing the company, the chairman mentioned the large amount of German goods dumped here in anticipation of the safeguarding duty, the increase in the bank rate, and the new Insurance Act, which would cost an additional £1000 a year.

Boring for Coal.

Speculation as to the extent of the coalfield beyond the limits in South Yorkshire, Derbyshire and North Nottinghamshire, which have already been well proved, has been largely removed by the operations of the Lincolnshire Boring Syndicate, which was formed to prospect for coal measures in that county. At the annual meeting the chairman stated that it had proved beyond doubt that the Midland coalfield extends into Lincolnshire. Boring stopped at a depth of 1200 yards, but before then, coal measures were struck at 703 yards and eleven seams were pierced.

Fen Country Electricity.

The Electricity Commissioners have informed the Spalding Council that they are still strenuously opposed to the erection of a generating station for Spalding, but that they would sanction an underground main from Peterborough Corporation works to Spalding, at a capital cost of approximately £20,000.

Hull Bridge Scheme.

The opposition to the North Bridge scheme over the river Hull, to which I referred last week, resulted in a poll being taken of the ratepayers, and it was found that 11,122 votes were cast in favour of, and 2195 against, the scheme.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

PROSPECTS in the Cleveland pig iron trade continue to brighten, and the position generally is very encouraging. Home consumers, having benefited by the new impulse in industry, have not hesitated to follow last week's advance in price, and a substantial business has been done with English and Scottish foundries. The export trade continues very quiet, present prices being much too high to permit of successful competition for any substantial volume of continental trade, but there are always a few European buyers who prefer Cleveland iron, and to them small parcels are being shipped. However, the home trade is the chief market for Cleveland pig iron, and at present it is sufficient to absorb all available supplies. The whole of the output is passing into immediate consumption, and but for the element of uncertainty regarding the outlook in the coal industry, it is possible that more furnaces might be set to work. At the moment, iron masters are not prepared to take the risk, although thinking men are convinced that expansion of output—and the consequent automatic reduction of the cost of production—is a more desirable aim than restriction and price inflation. Of course, it is idle to talk of inflation when present pig iron prices do not cover costs, but compared with other producing areas 70s. is probably a full price, and at all events there has been no attempt this week to push quotations up further, even though makers have very little iron to sell. A gratifying feature is that buyers are displaying great confidence and have placed contracts as far ahead as June. Home quotations, to which 6d. per ton must be added for export, are as follows:—No. 1 Cleveland foundry iron, 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; No. 4 forge, 68s. 6d.; and mottled and white, 68s.

Hematite Pig Iron.

There is an undiminished demand for East Coast hematite pig iron, both for home consumption and also for export, and as no increase in the number of furnaces has been made, makers are in a strong position. For early deliveries of East Coast mixed numbers they continue to quote 77s. 6d., and 78s. per ton for No. 1 quality, but rather higher figures are asked for March–April.

Ironmaking Materials.

Imports of foreign ore in fulfilment of old contracts are heavy, and though new business matures slowly, sellers are markedly disinclined to make price concessions. Best Rubio ore is firm at 21s. 6d. per ton, c.i.f. Tees. Quotations for blast-furnace coke vary considerably, but requirements continue on a very heavy scale, and with supply none too plentiful, there seems little likelihood of prices taking a downward turn. Good average qualities are in the neighbourhood of 22s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The increased activity which has characterised the manufactured iron and steel trade since the beginning of the year is well maintained. Buyers are evidently convinced that there is no advantage to be gained by waiting, and orders are coming forward freely. It is noticeable, too, that a good deal less continental semi-steel is now coming into the district, several firms now rolling from English sheet bars where they used to rely on imported material. Steel rail makers and producers of constructional steel have a fair number of contracts running, and sheet manufacturers are very fully employed. Makers of shipbuilding requisites are still greatly in need of work, but they report that inquiries are rather better. Prices generally are unchanged.

The Coal Trade.

Under pressure of a very heavy demand, prices in the Northern coal trade have advanced during the week from 6d. to 1s. per ton, and everything is favourable to a continuance of the present firmness. Tonnage is very well to hand, and there is little hindrance to a steady clearance at the loading berths. Notwithstanding the higher prices asked by fitters, the demand is well maintained, with the result that bookings for February, and even until the end of March, are satisfactory. The restarting of collieries has had no effect upon prices, and it would seem that even if Durham got her idle collieries under way again, the production would be absorbed just as rapidly as it has been in Northumberland, where there is now only one colliery idle, and it is in a state of partial dismantlement. The reason for the heavy demand is not altogether easy to explain, for the general improvement in trade has not been sufficient to account for it. The great circumstance which has brought about this rush for coal is perhaps the continued wintry weather throughout the whole of Europe, as far south as the Mediterranean. The recent heavy sales of Northumberland steams seem to have detracted little from the demand, which continues to be in some excess of the supply. Best Blyth qualities are particularly scarce and firm, with 17s. quoted as a minimum. Others are similarly strong, Tyne primes and North Northumberland sorts improving to 16s. to 16s. 6d., and seconds to 16s. Steam smalls are not in large supply, and, under a fair inquiry, prices are steady. There are eager inquiries for Durham coals, and supplies can be disposed of advantageously. Not many sellers are about, however, and that tends to harden the market. Gas coals are almost unobtainable until a week or two ahead, and the feeling is stronger. Bests are from 17s., and superior qualities command up to 17s. 6d. There is a good outlet for coking coals, especially inland, and 16s. 6d. for favoured unscreened sorts, and 16s. 3d. for lesser brands are easily made. In the coke market, gas makes receive the bulk of the demand, but actual business is quiet, as producers have full turns to the end of February, and can only book sparingly. Prices asked are unchanged from last week, but very firm at 24s. 6d. to 25s. 6d. Inquiry for foundry coke has rather fallen off, and the position is hardly steady at 22s. to 23s.

SCOTLAND.

(From our own Correspondent.)

Continued Quietness.

GENERALLY speaking, there has been no particular change in the Scottish steel and iron trades, and markets remain slow and without fresh interest. Activities are once again on the scale prevalent for a considerable period now, but the hopes entertained prior to the holidays, that an improvement in trade was imminent, have not yet been realised. The prices obtainable offer little inducement to the manufacturer at home, while competitive imported materials can be purchased on more favourable terms from the consumers' point of view. It is hoped that the discussions and conferences presently under weigh in various industries may result in the establishment of conditions whereby producers at home will be enabled to market their goods in open competition with continental and other sources of production. Meanwhile the outlook is not inspiring, and any attempt to stabilise prices is foredoomed to failure.

Steel and Iron.

Steel makers report a slight improvement in the demand for plates, but a lack of business in sections. Export is better than the home demand, but there is ample room for improvement in both. Prices are practically unaltered. The bar iron works have been a shade busier, but the demand for iron is only steady, and the improvement is noticeable only in the re-rolled steel department. Quotations are unaltered.

Steel Sheets.

Steel sheet makers report steady bookings for black and galvanised sheets of the lighter gauges. Export demands for flat and corrugated sheets are satisfactory, and home requirements are apparently growing. Specifications for thicker sheets are not too prolific.

Wages in the Manufactured Iron Trade.

Intimation has been made to the Scottish Manufactured Iron Trade Conciliation Board that as the average net selling price of iron during the months of November and December last has been certified at £11 16s. 7.87d., there will be a decrease of 2½ per cent. in the wages of the workmen.

Pig Iron.

There has been a rumour that pig iron prices will be increased soon, but in view of the scarcity of business any appreciation in prices is most unlikely at present.

Wages in Pig Iron Trade.

In view of the fact that an examination of the employers' books for October, November and December, 1925, brings out the average net selling price of pig iron at £4 0s. 9d. per ton, there will be a reduction of 3 per cent. on basis rates in the wages of workmen.

Shipbuilding and Shipping.

The directors of the Glasgow Shipowners' Association in their report make reference to the Merchant Shipping (Convention) Act. This report states that the Board of Trade has already adopted a considerable number of the regulations in the Convention, with the result that British shipowners are finding themselves with various restrictions and obligations which continental shipbuilders are not called upon to observe. The serious effect on shipping is emphasised by the fact that this country is the only one which has to any great extent enforced the provisions of the International Convention. Consequently, the cost and running of British ships is increased, through the operation of regulations, while competitors can ignore almost the whole of these regulations.

Coal.

A decided improvement in the export branch of the Scottish coal trade is reported. Some buyers have been anticipating requirements and also covering sales over a period, with the result that certain fuels are wholly taken up some time ahead. All classes of screened coal are firm, with Lanarkshire splints particularly well placed. Navigation fuels are well booked, while splints are booked until the end of next month. Ayrshire, Fifeshire and Lothians fuels all show a firmer tone. Washed materials in all districts are comparatively steady, with treble nuts the chief feature. Aggregate shipments amounted to 251,966 tons, against 260,403 tons in the preceding week and 224,006 tons in the same week last year. Fresh demands for anthracite smalls and gas coke on American account have been reported, and these sorts are firmer in price. In the home market supplies for municipal purposes are heavier, and the demand for household coals of high-grade quality is insistent.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE improved tone in the steam coal trade has been well maintained, but whether shipments this week will come up to the level of those last week is rather doubtful, as it is questionable whether there will be sufficient tonnage at the disposal of the collieries to enable this result to be achieved. Last week shipments were about 180,000 tons more than those of the preceding week, the total being rather more than 546,000 tons. Tonnage is just about equal to the loading berths available, but there is no undue pressure. There has been a fair amount of chartering, but apart from the fact that prompt tonnage is by no means too plentiful, the movement of steamers has been hampered by bad weather, and this fact may have a dislocating effect upon some of the collieries' arrangements. On paper the bulk of the collieries are well placed, and, in fact, it is a very long time since they were so well sold. Many of them have very little coal to offer for February shipment, and their position will be satisfactory, provided the tonnage comes along to time. Although not pronounced, except in the case of a few descriptions, principally superior small coals, the market is better, and this improvement is simultaneous with an advance in freight rates, which is a somewhat rare occurrence. The two markets do not as a rule move in the same direction together. Certainly there has been a better inquiry for coals from many directions, very largely for the re-stocking of coaling depôts abroad, but it would not be surprising to see fairly good conditions prevailing from now up to the end of April. The bare possibility of trouble arising with the miners is sufficient to make consumers abroad take precautions to have a good supply of coals, and the bulk of the new business coming to hand is for shipment within the next three months. This is the case with the Andalusian Railways of Spain, which are in the market for 20,000 tons of large coal, while the French Marine has asked for prices for 50,000 tons of large coal or patent fuel for delivery from March to July.

Tin-plate Pool.

At the end of last week a meeting of the recently established pool committee of the Tin-plate Conference (1925) unanimously decided to put the pool into operation as from Monday, February 8th. The purpose of this pool is to obtain an equitable distribution of orders, and so eliminate competition. The pool committee was appointed to draw up a scheme to achieve this object, but its exact details have not been divulged. The pool is expected, however, to have a beneficial effect upon the trade as a whole, and, in addition, the workmen should benefit, inasmuch as all will share in the work, and there will not be large sections employed while others are idle. The men's section of the Industrial Council has now formally presented the three months' notice necessary for the termination of the present sliding scale agreement at the annual meeting in May, the object being to secure a revision of the basis on which the scale works. In the meantime, application has been made for a continuance of the *ex-gratia* payment of 7½ per cent. for the next three months. During last year the employers conceded this bonus on the understanding that the sliding scale agreement should continue in force.

Steel Workers' Wages.

According to the quarterly ascertainment to the end of December last, the average price of steel bars from the works affiliated to the South Wales Siemens Steel Association is £6 4s. 5½d., equivalent to 11½ per cent. on the wages sliding scale. Under the previous ascertainment the percentage was 13¾. In the ordinary course, this would mean a reduction in wages of the steel workers for the period from February 6th to May 1st next, but, as already mentioned, the Industrial Joint Standing Committee has agreed instead of granting claims for increases that the decrease shall not take effect during the next three months.

Threatened Stoppage.

It was feared at one time that there might be a stoppage of work at Baldwin's iron and steel works at Port Talbot. A few days ago about twenty-five workmen were suspended by the management for the reason that they were in arrears with their union. According to a statement made by the management, pressure was brought upon it by the trade union leaders to take this action. The men alleged victimisation and threatened action, but since then the threatened stoppage has been averted, it being stated that the bulk of the workmen who were in arrears are now back at work.

New Coaling Appliances.

The chief docks manager of the Great Western Railway Company placed on view at the Cardiff Coal and Shipping Exchange on Monday the model of a new coal-shipping appliance which the company intends to install at the Newport docks. It is in the form of a new conveyor to be erected alongside No. 20 hoist, so as to provide means for the rapid loading of vessels by shipping through the hoist and the conveyor simultaneously. The conveyor has been specially designed for dealing with large coal, and, it is estimated, can ship at the rate of 1000 tons per hour from 20-ton wagons. At the King's Dock at Swansea on the same day a trial was given to an anti-breakage device for use in the loading of anthracite coal. This is the patent of Mr. Rees Davies, and consists of a large box divided into three sections with a ring in each, which is fixed at the end of the chute of a coal tip and raised on two beams across the hatchway. The coal on being tipped runs into this box, with the result that the speed of the rush is checked and breakage is considerably reduced.

Tin-plates for America.

The Harrison liner Dictator is loading at the King's Dock, Swansea, 20,000 boxes of tin-plates for San Francisco, this being part of an order obtained by the Grovesend Steel and Tin-plate Company amounting to 6000 tons or 70,000 boxes.

Current Business.

Operations on the steam coal market have been more active and the tone throughout is firmer, with the possible exception of dry large coals. In the case of best Admiralty large coals, these are quoted up to as much as 24s. 6d., and seconds are very steady at 22s. 6d. Small coals have firmed up and best descriptions range from 14s. to as much as 15s. Dry nuts are firm on account of the demand for early loading for America. There has not been any material change in patent fuel and coke. Anthracite coals display very little alteration, but as it is believed that a settlement of the American anthracite miners' strike may be announced at any moment, the tendency of values is rather in a downward direction, though there has been no definite movement in prices so far.

LAUNCHES AND TRIAL TRIPS.

AZANIA, steamer; built by Ferguson Bros. (Port-Glasgow), Ltd., to the order of the Crown Agents for the Colonies; dimensions, 125ft. by 29ft. by 11ft. 6in. Engines, twin-screw, compound surface-condensing; constructed by the builders; launch, January 14th.

CARNARVON CASTLE, motor vessel; built by Harland and Wolff, Ltd., to the order of the Union-Castle Mail Steamship Company, Ltd.; dimensions, 655ft. 9in. by 73ft. by 45ft. 6in. Engines, double-acting, eight-cylinder, four-cycle, Harland-B. and W. Diesel; constructed by the builders; launch, January 14th.

TETELA, single-screw steamer; built by Cammell, Laird and Co., Ltd., to the order of Elders and Fyffes, Ltd.; dimensions, 400ft. by 51ft. by 32ft. 11in. Engines, triple-expansion reciprocating, 27½in., 46½in. and 78in. diameter by 54in. stroke, pressure 210 lb.; constructed by the builders; launch, January 14th.

PERSONAL AND BUSINESS ANNOUNCEMENTS

BURDONS, Ltd., requests that, in future, all communications for it shall be addressed to 195, Scotland-street, Glasgow.

WE are asked to state that arrangements are being made by the Westinghouse Brake and Saxby Signal Company, Ltd., for the establishment of service and fitting stations throughout the country, and that Carrimore Six Wheelers, Ltd. (the works of which are situated on the Great North Road, North Finchley, N. 12, between Whetstone and Tally Ho Corner), has been appointed service and fitting agent for the London area and the home counties.

WE are asked by C.A.V. Small Tools, Ltd., of Portland-road, Portslade, Brighton, Sussex, to announce that it has concluded arrangements with Lehmann Archer and Co., Ltd., of 5, Farringdon-road, London, E.C. 1, whereby the latter have taken over the selling and distributing organisation for all the former's standard lines so far as home trade is concerned. This arrangement will not affect the Portslade firm's specialised jig, fixture, and press tool work, which it will continue to carry on direct.

FRANCIS MORTON AND CO., Ltd., of Garston, Liverpool, advise us that, consequent upon the death of their London manager—Mr. C. G. Russell—they have decided to transfer their London representation from that of a branch office at 17, Victoria-street, Westminster, S.W. 1, into the hands of an agent. They have therefore appointed Mr. Raymond Gill, Assoc. M. Inst. C.E.—trading as Raymond Gill and Co.—with offices at 92, Victoria-street, Westminster, London, S.W. 1, as their agent, and he will look after their interests in London in the future.

CARNIVAL DANCE.—The Igranic Electric Company, Ltd., held its annual carnival dance on Friday, 15th inst., at the Café Dansant, Bedford. Many of the party, which numbered 500 and included contingents from the London, Birmingham, Manchester and Leeds offices of the company, were in fancy dress, and prizes were awarded by a special judging committee for the best costumes.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	21/-
(1) Spanish	18/6
(1) N. African	18/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 6	3 17 6
No. 1	3 18 0	3 18 0
Cleveland—		
No. 1	3 12 6	3 13 0
Silicious Iron	3 12 6	3 13 0
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 9 0
Mottled	3 7 6	3 8 0
White	3 7 6	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
" " Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0	—
" Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 3 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 10 0 (a) / 4 12 6 (b) / 4 17 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	11 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 5 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 11 0 0	
Gas Tube Strip	12 5 0 to 12 10 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¾in. and up.	7 10 0 to 7 12 6	
Sections	7 0 0 to 7 2 6	
Steel Sheets, under 3/16in. to ¼in.	9 0 0 to 9 2 6	
Sheets (Gal. Cor. 24 B.G.)	—	£17 to £18

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 7 6	—
Angles	7 0 0	—
Boiler Plates	11 10 0	—
Joists	7 0 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light "	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 5 0 to 8 10 0	
" (others)	8 0 0 to 8 5 0	
Hoops (Best)	15 5 0	15 0 0
" (Soft Steel)	13 15 0	13 10 0
Plates	7 17 6 to 8 5 0	
" (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 17 6 to 8 0 0	
Billets and Sheet Bars	6 2 0 to 6 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 7 6 to 16 12 6	
Angles	7 0 0 to 7 5 0	
Joists	7 0 0 to 7 5 0	
Tees	8 0 0 to 8 5 0	
Bridge and Tank Plates	7 15 0 to 8 0 0	
Boiler Plates	11 0 0 to 12 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	277 15 0
" (three months)	273 12 6
Copper (cash)	58 10 0
" (three months)	59 12 6
Spanish Lead (cash)	34 5 0
" (three months)	34 13 0
Spelter (cash)	37 0 0
" (three months)	36 12 6
MANCHESTER—	
Copper, Best Selected Ingots	65 10 0
" Electrolytic	66 10 0
" Strong Sheets	90 0 0
" Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
" Condenser	0 1 2½
Lead, English	37 0 0
" Foreign	36 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/1 per lb.	
Ferro Tungsten	1/10 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	8/-
" 6 p.c. to 8 p.c. "	£23 0 0	7/6
" 8 p.c. to 10 p.c. "	£22 7 6	7/-
" Specially Refined		
" Max. 2 p.c. carbon	£40 10 0	14/-
" " 1 p.c. "	£49 0 0	16/-
" " 0·70 p.c. carbon	£56 0 0	17/6
" " carbon free	1/5 per lb.	
Metallic Chromium	3/6 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 15 0	scale 5/- per unit
" " 75 p.c.	£21 10 0	scale 6/- per unit
" Vanadium	15/3 per lb.	
" Molybdenum	6/1 per lb	
" Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£172 to £177	
Cobalt	10/- per lb.	
Aluminium (per ton)	£120	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/9
" " Ell	18/-
" " Splint	19/- to 22/6
" " Trebles	18/-
" " Doubles	16/9
" " Singles	14/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/-
" " Jewel	18/-
" " Trebles	18/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	14/3 to 17/-
Screened Navigation	21/6
Trebles	18/6 to 19/6
Doubles	16/9
Singles	15/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	16/3
Secondary Steam	15/6
Trebles	18/-
Doubles	16/9 to 17/-
Singles	14/9

ENGLAND.

(8) N.W. COAST—	
Steams	23/6
Household	40/- to 45/-
Coke	27/-
NORTHUMBERLAND—	
Best Steams	17/-
Second Steams	16/-
Steam Smalls	9/9 to 10/-
Unscreened	14/-
Household	20/- to 22/-
DURHAM—	
Best Gas	17/-
Second	16/3 to 16/6
Household	20/- to 22/-
Foundry Coke	22/- to 24/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	26/- to 27/6 —
" " House	24/- to 25/- —
" " Large Nuts	17/- to 20/- —
" " Small	12/6 to 14/- —
Yorkshire Hards	17/- to 19/6 —
Derbyshire "	16/- to 19/- —
Rough Slacks	10/- to 12/6 —
Nutty "	7/6 to 9/- —
Smalls	3/6 to 6/- —
Blast-furnace Coke (Inland)*	— —
" " (Export)	f.o b. 19/3 to 19/9

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	23/- to 24/-
Second " "	21/6 to 22/6
Best Dry Large	21/- to 22/-
Ordinary Dry Large	20/6 to 21/-
Best Black Vein Large	21/- to 21/6
Western Valley Large	20/- to 20/6
Best Eastern Valley Large	20/- to 20/6
Ordinary " "	19/- to 20/-
Best Steam Smalls	13/- to 14/-
Ordinary "	11/- to 13/-
Washed Nuts	19/- to 28/6
No. 3 Rhondda Large	27/- to 27/6
" " Smalls	17/- to 18/-
No. 2 " Large	17/6 to 18/-
" " Through	16/- to 17/-
" " Smalls	10/6 to 11/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 22/6
Pitwood (ex ship)	24/- to 25/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	41/6 to 42/6
Seconds	32/6 to 37/6
Red Vein	28/- to 31/-
Machine-made Cobbles	52/6 to 55/-
Nuts	55/- to 57/6
Beans	42/6 to 45/-
Peas	21/- to 24/-
Breaker Duff	8/6 to 8/9
Rubbly Culm	9/6 to 10/-
Steam Coals :	
Large	22/- to 23/6
Seconds	20/- to 22/-
Smalls	9/- to 10/-
Cargo Through	16/6 to 18/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Flood Protection.

AN explanation of the delays in carrying out the works which are to protect Paris, as well as the valley of the Seine as a whole, from the effects of inundations was given during a debate in the Senate, when it was affirmed that the State had contributed only a small proportion of the cost already incurred, and was unable at present to provide any further funds, though recent experience has shown how urgent is the necessity. There was a general opinion that one of the main causes of the periodical floods is the rapid deforestation, which, according to the Minister of Agriculture, is taking place at the rate of 250 acres a day, but while a policy of systematic afforestation is included in the plan, it cannot take the place of the works of protection which must be carried out as rapidly as possible. A solution is likely to be still further delayed by the way in which the various schemes are perpetually discussed. The overflow canal from the Marne to the Seine is regarded as offering some protection to Paris, but is likely, it is said, to increase the risks of disastrous flooding below the city. The reservoirs in the upper valley of the Seine, while regulating the level of the river and providing Paris with a practically unlimited supply of water, are believed by some to threaten an aggravation of floods. Nevertheless, the Paris Municipal Council has declared itself in favour of the construction of flood reservoirs, and has approved of the building of one as an experiment. Apart from the dredging of the Seine, which will be done to a limited extent, and to the purely local works of protection, the proposed construction of flood reservoirs is meeting with most support, because it is the only scheme that offers promise of a drastic solution.

Tunnelling the Vosges.

Soon after the Armistice one of the first schemes put forward was the driving of tunnels through the Vosges, so as, figuratively, to break down the barrier which isolates Alsace from the rest of the country. At present the only tunnel being constructed is the one between Saint-Dié and Saales. The others proposed to be put in hand are from Saint-Dié to Sainte-Marie-aux-Mines, between Cornimont la Bresse-Metzeral and from Saint-Maurice to Wesserling, and if the projects have not yet been finally sanctioned by Government, it is only because there appeared to be no necessity to hasten the work in view of the lack of funds to carry it through. Now that the Dawes scheme provides for the supply by Germany of the rails, sleepers, locomotives, structural and other material necessary for the equipment of the tunnels, the Commission de la Percée des Vosges met in Paris last week to make arrangements for the preparation of a financial scheme which will be submitted to Government. It is understood that the Cie des Chemins de Fer de l'Est is prepared to take upon itself the task of financing the undertaking if it is granted the concession for the construction of the tunnels.

Miners' Wages.

The coalowners, having decided some time ago to withdraw their demand for a reduction in miners' wages on the understanding that the Government would take such steps as were necessary to keep up the prices of coal on the home market, the situation is now undergoing a distinct change for the worse through the Committee of the Miners' Federation calling upon the Government to intercede with the colliery companies for an advance of wages of not less than 15 per cent. as compensation for the higher cost of living. If the advance is not granted by the end of the month, a vote will be taken upon the desirability of a general strike. If the coalowners bring forward the arguments they adduced three months ago, it is difficult to see how a conflict can be avoided, for they were able to prove that many collieries were being worked at a loss, and that if further charges were imposed upon them they would have to be closed down. Since then they have been living in the hope that the industry would be assisted by the State, particularly in the way of obtaining a preference for French over foreign coal.

Automatic Couplings.

The only automatic couplings which have obtained any success in trials in this country are the Henricot and the Boirault, the latter having been employed for many years on the electric trains running between Paris-Invalides, and Versailles. Very strong pressure was brought to bear upon the Government some time ago to obtain from the Chamber of Deputies the credits necessary for equipping the railway coaches with the Boirault apparatus, on the ground that it was better to employ a tried coupling than to wait indefinitely for something better. It was then stated that the Office Central d'Etudes du Matériel was experimenting with a new automatic coupling, which now appears to be the Willison, and trials have been carried out at Trappes in the presence of railway engineers, who, it is declared, were satisfied with the results.

Foreign Trade.

The returns of foreign trade during 1925 indicate a curious discrepancy in tonnage and values. The imports were valued at 43,980 million francs an increase on the year of 4052 millions. The values of exports were 45,413 millions, an augmentation of 3945 million francs. During the latter part of the year import values advanced rapidly every month. This coincided with the fall in currency values, which meant that this country had to pay more francs for what it purchased abroad, for while there was an increase in the values of imports the tonnage declined by 9,165,791 tons, the total for the year being 47,425,572 tons. At the same time the exports totalled 30,225,982 tons, an increase on the year of 838,892 tons, so that the rate of increase in values was much less in the case of exports than of imports. Obviously, therefore, owing to the depreciation of the franc, the French have been paying more for their raw material purchased abroad and have been selling their goods in foreign markets at lower prices.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

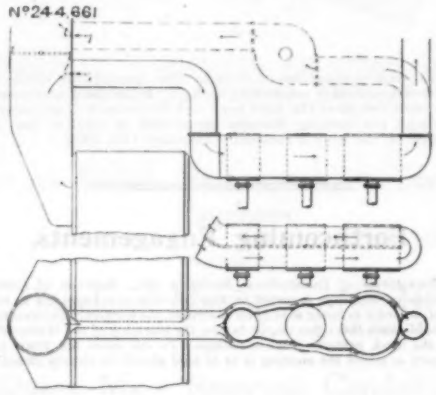
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM ENGINES.

244,661. June 29th, 1925.—JACKETING CYLINDERS, F. Robinson, The Hollies, Wylam-on-Tyne.

The inventor proposes to jacket the cylinders and valve chests

N°244,661



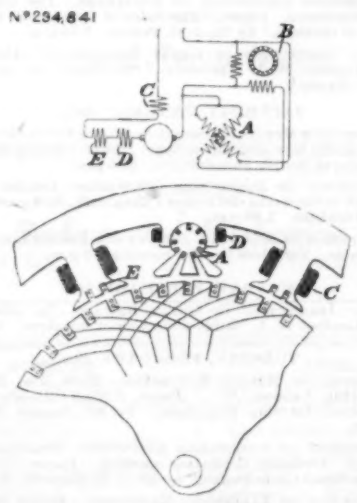
of steam engines with flue gases from the boiler furnaces. The gases are by-passed from the uptake and circulated through the jackets by means of a fan, as shown.—*December 24th*, 1925.

DYNAMOS AND MOTORS.

234,841. May 29th, 1925.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, of Crown House, Aldwych, W.C. 2.*

This invention relates to alternating-current commutator motors and has for its object the provision of an improved arrangement for facilitating the commutation of such motors at low speeds and under all conditons of operation. In order to

N°234,841



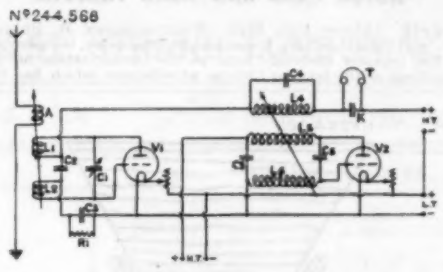
overcome sparking at low speeds a localised revolving field is provided in the neutral zone of the motor, for the purpose of inducing an electromotive force in the short-circuited armature coils. For the purpose of energising the polyphase winding A, any well-known form of phase converter as shown at B may be employed. The functions of the field windings C, D and E will be understood from their positions on the lower drawing.—*December 24th*, 1925.

TELEGRAPHS AND TELEPHONES.

244,568. November 14th, 1924.—IMPROVEMENTS IN AND RELATING TO RECEIVERS FOR WIRELESS TELEGRAPHY AND TELEPHONY, Claude Seymour, Captain, Royal Navy; George Alexander Irving, and James Clarence William Drabble, all of H.M. Signal School, R.N. Barracks, Portsmouth, Hampshire.

This invention relates to receivers for wireless telegraphy and telephony, and more particularly to valve receivers or amplifiers in which great amplification of high-frequency current is obtained, such as devised by Armstrong. The constants of the circuit L_2 L_3 C_3 C_2 are so chosen that for an applied high-tension voltage to the valve V_1 above a definite value—say, x volts—the circuit will oscillate, while below that value the free oscillation will not build up. Superimposed on the high-tension direct-current voltage is the alternating-current voltage at the quenching frequency induced in the circuit L_4 C_4 by coupling to the generating circuit L_2 L_3 C_2 C_3. The direct-current and quenching components of the high-tension voltage are then adjusted so that during some portion of the quenching cycle the resultant voltage applied to the valve V_1 is greater than the value x volts. For the remainder of the quenching cycle the resultant voltage applied is less than this value. The amplitude of the quenching voltage applied to the anode of the valve V_1 may be varied by means of the coupling between the circuit L_4 C_4 of the anode supply circuit and the oscillating or generating circuit including the valve V_2. The variations in grid potential of the valve V_1 caused by the electromotive forces induced in L_4 C_4 L_2 C_2 by the received signal cause variations in the mean current supply to the valve V_1, which for the case of I.C.W. reception set up a corresponding I.C.W. note in the telephone T or other receiver. By the provision of the condenser C_5 and the shunting resistance

N°244,568



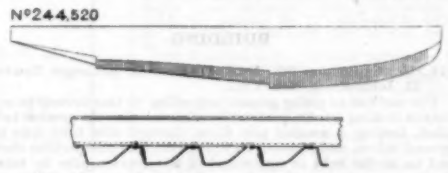
R_1 two functions are performed, namely, the rectifying action of the valve V_1 is improved and by a suitable choice of values of the condenser C_5 and the resistance R_1 the grid of the valve V_1 may be kept at the correct potential for the best operation of the circuit.—*December 24th*, 1925.

AERONAUTICS.

244,520. September 17th, 1924.—HULLS OF FLYING BOATS, S. E. Saunders, Medina Works, East Cowes, Isle of Wight.

It is stated in this specification that the longitudinal corrugation of the hulls of flying boats is unsatisfactory, as the water clings to the rounded or corrugated surface and sets up undue resistance to the passage of the boat through the water. There

N°244,520



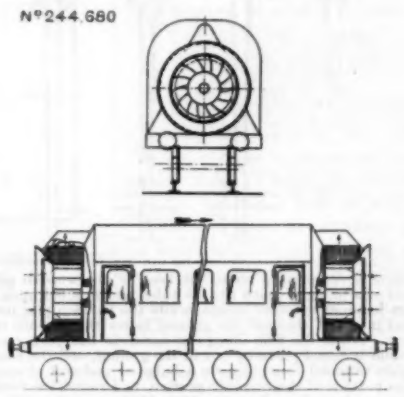
is also a difficulty experienced in arranging all the corrugations to run directly fore and aft, that is to say, in the direction of the true stream of water, with the result that eddies are formed in the water, which eddies also set up undue resistance. The inventor consequently arranges corrugations transversely or athwartships in saw tooth fashion, and claims that they are conducive to speed.—*December 17th*, 1925.

LOCOMOTIVES.

244,680. August 29th, 1925.—OIL ENGINE-DRIVEN LOCOMOTIVES, *P. C. Rushen, 28, Southampton-buildings, Chancery-lane, London, W.C. 2.*

In this specification the inventors suggest that one of the main problems in the design of internal combustion locomotives is the provision of adequate cooling arrangements, specially in the

N°244,680



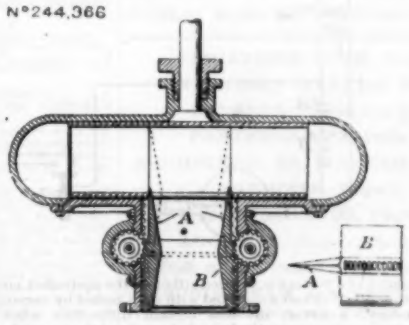
larger sizes and in those sets which are required to run in either direction regardless of the direction of rotation of the engine. For this reason, in the place of the usual transverse radiator and axial flow fan, they employ annular radiators, as shown in the drawing, and fans with axial inlets, but with radial discharge through the radiators.—*December 24th*, 1925.

PUMPING AND BLOWING MACHINERY.

244,366. August 5th, 1925.—DREDGING PUMPS, B. F. Dupont, P.O. Box 1363, Miami, Florida.

This pump is intended for dredging purposes where the

N°244,366



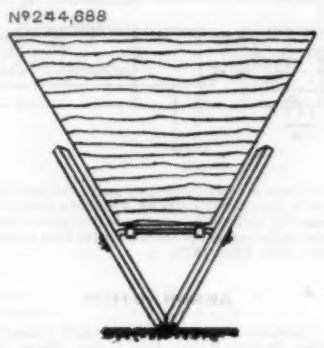
impeller is liable to be choked with *débris* such as roots. The eye of the impeller is consequently made open and into this opening there can be projected a pair of cutters A A mounted

on a sleeve B. This sleeve is housed in the inlet branch and can be operated by the gearing shown. In use the cutters are advanced while the impeller is rotating and cut up any obstruction.—*December 17th*, 1925.

MOTOR CARS AND ROAD TRAFFIC.

244,688. October 10th, 1925.—WHEELBARROWS, H. Büssing und Sohn G.m.b.H., Elmstrasse 29, Brunswick, Germany.

The inventor obviously aims at the circumvention of the handicap of the familiar Chinese wheelbarrow, which has the



wheel protruding through the centre of the load. He employs two wheels "inclining downwardly so that the running faces of the two wheels lie immediately adjacent," as plainly shown in the illustration.—*December 24th*, 1925.

BUILDING.

244,375. September 9th, 1925.—PILING, D. McGregor Newton, 55, John-street, New York.

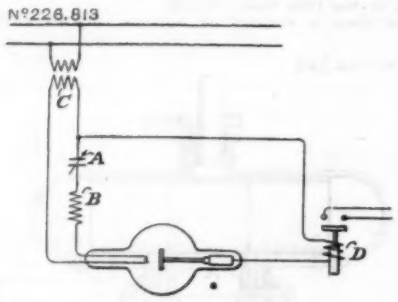
The method of piling ground according to this invention consists in sinking a tube, preferably of metal, into the ground to be piled, forcing a wooden pile down through this tube into the ground below, and forming an upper concrete pile portion above and on to the butt or upper end of the wooden pile, by introducing concrete into the tube so that the lower end of the concrete engages and makes joint with the wood pile. Further, the

concrete is compressed on to the head of the wooden pile by means of a plunger which fits the tube, and is acted upon by a steam hammer or other means, while the wooden pile itself is forced into and through the ground below the bottom of the casing. When the first charge of concrete has been rammed the tube is raised partially out of the ground, and the concrete is again rammed so as to form a bulge or pedestal of concrete at the bottom of the concrete portion, and round the butt end of the wooden pile.—*December 17th*, 1925.

MISCELLANEOUS.

226,813. December 29th, 1923.—IMPROVEMENTS IN AND RELATING TO ELECTRIC RELAY SYSTEMS, *The British Thomson-Houston Company, of Crown House, Aldwych, W.C. 2.*

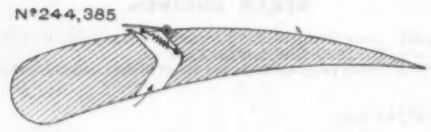
It is sometimes desirable to control the connection of one or more electric circuits in accordance with the change in the



frequency of a voltage impressed either on the controlled circuits or on another circuit associated with it. Control by varying the frequency, however, involves certain difficulties when the frequencies are comparatively high, because of the unsatisfactory operation of a coil-operated switch, the operating coil of which constitutes a high and variable reactance in the high-frequency circuit. In order to avoid these difficulties it is proposed to provide an arrangement for operating one or more switches by unidirectional current of a value which is determined by the frequency of the circuit from which current for actuating the switch or switches is supplied. The condenser A and the reactance B, together with the secondary winding C of the transformer from a resonant circuit, by means of which the value of the filament current and consequently that of the rectified current in the coil D, may be controlled in accordance with the frequency of the voltage impressed on the primary of the transformer.—*December 24th*, 1925.

244,385. November 18th, 1924.—WINDMILL GOVERNING, *Aero-Dynamos, Ltd.*, 91, *Bishopsgate, London, E.C. 2.*

This invention is concerned with the governing of windmills to maintain a constant speed. The wings of the wheel, of which a sectional drawing is given, are of stream-line form and are pro-



vided with perforations as shown. The openings are closed by hinged flaps held in position by springs. When the wind pressure becomes too great the flaps open and the current of air passing through the opening disturbs the stream of wind so that its action on the wing is reduced.—*December 17th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Mechanical Excavators and Concrete Mixing Machinery," introduced by Mr. F. H. Livens. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Grand Hotel, Sheffield. Paper, "Modern Developments in Open-hearth and other Steel Works Furnaces," by Mr. A. Vincent Kemp. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—Philosophical Hall, Park-row, Leeds. Paper, "The Arc Welding of Seams in Steel Plates," by Mr. J. T. Carr. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Comfort in Railway Travel from the Point of View of the Engineer," by Mr. A. N. Moon. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Manchester. Paper, "The Value of Research in the Production of Castings," by Mr. J. G. Pearce. 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse "On Films," by Sir W. B. Hardy. 9 p.m.

SATURDAY, JANUARY 30TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Neville Hall, Newcastle-upon-Tyne. Joint meeting with the Institution of British Foundrymen. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the works of Thomas Tilling, Ltd., Bull-yard, High-street, Peckham. 2.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Leeds. Yorkshire District meeting. 2 p.m.

MONDAY, FEBRUARY 1ST.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. General meeting of members. 5 p.m.

TUESDAY, FEBRUARY 2ND.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. Paper, "High-efficiency Steam Installations for Ship Propulsion," by Mr. Stanley S. Cook. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Developments in Motor Cycle Design," by Mr. J. R. Harnott. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND STUDENTS' SECTION.—The University, Edmund-street, Birmingham. Address by the President of the Institution, Mr. R. A. Chattock. 7 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Natural History Theatre, Beyer-building, The University, Manchester. Address, "Mining in Canada, with Regard to Migration," by Sir Stopford Brunton. 6 p.m.

WEDNESDAY, FEBRUARY 3RD.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Midland Hotel, Derby. Derby Graduates' annual dinner. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "The Propagation of Electric Waves," by Mr. J. Hollingworth. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—The Engineers' Club, Coventry-street, London, W. 1. Annual dinner. 7.30 p.m.

LIVERPOOL ENGINEERING SOCIETY.—9, The Temple, Dale-street, Liverpool. Paper, "Control Gear for Electric Motors," by Mr. J. H. Collie. 7.30 p.m.

THURSDAY, FEBRUARY 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with Royal Aeronautical Society. Paper, "American Aeronautical Engine Practice," by Mr. C. L. Lawrence. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Queen's Hotel, Birmingham. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Papers: "Power Factor and Tariff," by Mr. E. V. Clark; and "Power Factor Improvement," by Mr. E. W. Dorey. 6 p.m.

LIVERPOOL ENGINEERING SOCIETY.—Midland Adelphi Hotel, Liverpool. Annual dinner. 7 p.m.

FRIDAY, FEBRUARY 5TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Paper, "Principles and Practice in the Erecting Shop," by Mr. P. H. Saunders. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Question and discussion evening. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Shakespeare's English," by Professor G. Gordon. 9 p.m.

SATURDAY, FEBRUARY 6TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Manchester. Lecture, "A Day in the Foundry," by Mr. J. G. Robinson. 4 p.m. To be followed by annual dinner at 6.30 p.m.

MONDAY, FEBRUARY 8TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "Modern Chassis Frame Design and Body Mounting," by Mr. T. D. Carpenter. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES SECTION.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Submerged Combustion and Submerged Flame Burners," by Mr. E. C. Peters. 7 p.m.

TUESDAY, FEBRUARY 9TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "A Talk on Foundry Work," by Mr. H. Shackleton. 7.15 p.m.

WEDNESDAY, FEBRUARY 10TH.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—Northampton Polytechnic Institute, St. John-street, Clerkenwell, London, E.C. 1. Paper, "A General Survey of Chromium Plating," by Mr. E. A. Ollard. 8.15 p.m.

FRIDAY, FEBRUARY 12TH.

BOROUGH POLYTECHNIC INSTITUTE.—Borough-road, London, S.E. 1. Annual prize distribution. 7.30 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Application of Special Cast Irons in the Engineering Industry," by Mr. S. E. Dawson. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Refrigerating Machinery," introduced by Mr. G. C. Hodson. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. Paper, "The Choice of Steels for Engineering Work," by Mr. A. P. Hague. 7.30 p.m.

WOMEN'S ENGINEERING SOCIETY.—26, George-street, Hanover-square, London, W. 1. Lecture, "Some Problems of the Machinery Market," by Miss E. M. Kennedy. 6.30 p.m.

FRIDAY, FEBRUARY 19TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers Club, Coventry-street, London, W. 1. Annual dinner. 6.30 for 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Paper, "The Measurement of Cutting Temperatures," by Mr. E. G. Herbert. 6 p.m.

SATURDAY, FEBRUARY 20TH.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Dudley Arms Hotel, Dudley. Annual dinner. 6 p.m.

CONTRACTS.

LA COMPAGNIE INTERNATIONALE DES WAGONS-LITS has placed with the Leeds Forge Company, Ltd., of Leeds, the constructors of the original "Blue Train," an order for thirty all-steel Pullman cars for use on the Continent.

THE Roads Board of Queensland, Australia, has placed an order with Marshall, Sons and Co., Ltd., of Gainsborough, for six steam road rollers. The Country Roads Board of Victoria, Australia, has also ordered another steam road roller of Marshall make.

JOHN DAVIS AND SON (DERBY), Ltd., of All Saints Works, Derby, have received the contract for the electric lamp installation for the new Blidworth Colliery of the Newstead Colliery Company, Ltd., this contract being in addition to the contract for the other new colliery in the district, namely, the Firbeck Main Collieries, Ltd.

THE MIRRLEES WATSON COMPANY, Ltd., of Scotland-street, Glasgow, has just received from the Ilkeston and Heanor Water Board, Waterworks, near Matlock, an order for an electrically driven bore-hole pump capable of delivering 30,000 to 35,000 gallons of water per minute. The same firm has also received from Michael Nairn and Co., Ltd., Kirkcaldy, an order for two sets of surface condensing plant, each condenser having a cooling surface of 2140 square feet and capable of maintaining a vacuum of 28in. Hg., barometer 30in. Hg., when condensing 16,000 lb. of steam per hour and when supplied with 1980 gallons of circulating water per minute at an inlet temperature of 80 deg. Fah.

IT is officially announced by the Great Western Railway Company that the following contracts have been placed:—(*a*) Overhaul of the tug Clive, Messrs. Thomas Diamond and Co., Cardiff; (*b*) general overhaul and Board of Trade survey of ss. The Mow, Messrs. Philip and Son, Dartmouth; (*c*) supply of six 0-4-0 type tank locomotives for Swansea Docks, The Avonside Engine Company, Ltd., Bristol; (*d*) supply and erection of covered footbridge and platform covering at Newton Abbot, Jesse Tildesley, Ltd., Darlaston; (*e*) supply and erection of platform covering at Swansea (High-street Station), John Lysaght, Ltd., Bristol; (*f*) construction of bridge at Twyford, J. Cochrane and Sons, Ltd., London; (*g*) renovation and painting of Paddington Down Parcels Office, William Brown and Sons (Builders), Ltd., London; and (*h*) alterations to Receiving Office, 20, New Bond-street, Bath, Jacob Long and Sons, Ltd., Bath.

FARADAY MEDAL.—The Council of the Institution of Electrical Engineers has made the fifth award of the Faraday Medal to Colonel R. E. B. Crompton, C.B., honorary member of the Institution. The Faraday Medal is awarded by the Council of the Institution, not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution. Colonel Crompton, who has twice been president of the Institution, was one of the early pioneers of electrical engineering and has played an outstanding part in the development of electricity supply in this country.